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JULY 1961

RUBBER WORLD

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Elongation at Break, %	450	480	340	250
Izod Impact Notched ft.-lbs./in.	Flexed	Flexed	20	1.2
Split Tear, ASTM-D 470 lbs./linear inch	50	155	160	200
***Compression/Deflection, psi @ 5% defl.	575	750	1800	6000
Rebound Resilience, %	45	40	42	45
Oil Resistance	Excellent	Excellent	Excellent	Excellent
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*Softer compounds ranging from 10 Shore A are also available. **Samples pulled @ 1 in./minute (elastomer stocks normally pulled @ 20 in./min.) ***Shape Factor–1

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Polyurethane Materials

RUBBER WORLD

VOLUME 144 NUMBER 4 JULY, 1961

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SERVING THE RUBBER INDUSTRY SINCE 1889

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SHELL

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☐ 84 ☐ 107 ☐ 27

☐ 24 ☐ 136 ☐ 49

☐ 55 ☐ 120 ☐ 80

☐ All future Bulletins

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Synthetic Rubber Division
P. O. Box 216
Torrance, California

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Company _____

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FREE:

New Shell Bulletins present helpful data on two types of Shell Isoprene Rubber—clip coupon for these and any of seven others listed below

Shell's Technical Service Department has released two new Bulletins. They are yours for the asking.

One reports on the improved properties of Type 305 Shell Isoprene Rubber. The other presents data on a brand-new product—oil-extended Shell Isoprene Rubber Type 500.

These two Bulletins and any of the others listed below will help you increase the efficiency and reduce the cost of compounding and processing Shell synthetic rubber.

#84—*Compounding Type 305 Shell Isoprene Rubber.* Since its introduction in 1960, Shell scientists have improved the properties of their polyisoprene polymer. This 24-page Bulletin describes these improvements. It gives recent compounding and processing data.

#107—*Shell Isoprene Rubber Type 500.* New oil-extended, Type 500 Shell Isoprene Rubber is the first type of polyisoprene to cost the *same* as SBR. This 4-page Bulletin includes property, formulating and compounding data on this light-colored, economical polymer.

#27—*Microcellular sponge soling.* Gives formulas as well as data on precure, postcure, specific gravity and shrinkage for a range of density-hardness relationships in sponge shoe soling compounds.

#24—*Shell S-Polymer in shoe soles.* Formulas and physical properties for a variety of soles for work, dress and athletics.

#136—*Elastomer compounds for automotive applications.* Starting compounds and their physical properties which meet basic requirements of various grade numbers in ASTM D 735-55T, Type R, covering a durometer hardness range of 30 to 90.

#49—*Formulating for superior whiteness.* Shows effects on color reflectance of varying polymer, accelerator and filler before and after aging. Charts show actual colors of test samples.

#55—*Sulfur and accelerator requirements for typical Shell S-Polymers.* Shows effects of varied cure systems on physical properties and processing characteristics. Also shows relative accelerator levels for obtaining a uniform optimum cure for various S-Polymers.

#120—*Carbon black and mineral filler loadings with typical S-Polymers.* Effects of filler type and concentration on physical properties and processing characteristics.

#80—*A comparison of the physical properties and processing characteristics of typical S-Polymers.* Relative values for each Shell rubber in a constant formula. Properties after aging are also shown.

How to learn more

For complete information on Shell synthetic rubber, contact the Shell Synthetic Rubber Division sales office in Stamford, Connecticut, Cleveland, Ohio or Lakewood, California. Or write Shell Chemical, Box 216, Torrance, California.

A report from

Shell Chemical Company

SHELL

Synthetic Rubber Division

news of the rubber world

July, 1961

The Federal-Aid Highway Act of 1961 was signed into law on June 29 by President Kennedy. This bill raised the excise tax on highway tires and tread rubber 2¢ a pound and on tubes 1¢ a pound. While the increases were not so great as original Administration proposals, the bill was disappointing to the rubber industry which had advanced alternate proposals through the RMA and other trade associations. Other details in our Washington Report.

New lower prices for stereo rubbers were announced at the end of June. Firestone started the round by pegging the price of Diene (polybutadiene) at 30¢. Phillips followed with a price of 30¢ for Cis-4. Shell then announced a price of 26.1¢ a pound (25¢ f.o.b. Torrance) for Shell Isoprene, with the oil-extended Type 500 down to 22.6¢. Some softening of the natural rubber market was noticed in the wake of these announcements, with rumors persisting that there may be reductions in at least some SBR prices.

The International Institute of Synthetic Rubber Producers is gradually expanding plans for increased service to the manufacturers and the public. New president, Herman Thies (Goodyear), announced establishment of a Brussels office and plans to sponsor several fundamental research projects to help solve problems of production, engineering, safety, transportation, and others for the benefit of all. While moving cautiously, but logically, the Institute seems to be making good headway to becoming the effective association for this important manufacturing group in our industry.

The rubber export/import situation has been a matter of concern to many for some time. Recent Commerce Department figures show that in the last 10 years the United States has changed from an exporter of finished rubber products and an importer of raw materials to the completely opposite position.

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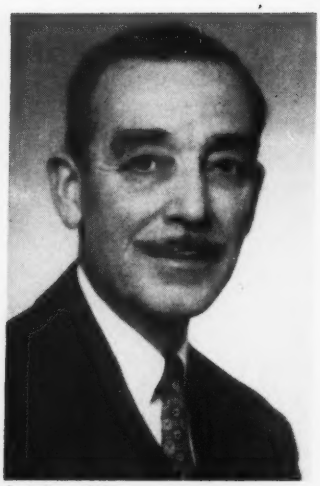
obituaries



Pach Bros., N.Y.

John P. Coe

John P. Coe

John Parks Coe, retired vice president of United States Rubber Co., New York, N. Y., and former general manager of its Naugatuck Chemical Division, Naugatuck, Conn., died suddenly in his home at Woodbridge, Conn., June 23.

Coe began his career with U. S. Rubber at its tire and bicycle tube plant in Indianapolis, Ind., soon after graduation from college. The following year he was assigned to the company's general laboratories. During World War I he worked at company plants in Naugatuck, Conn., and Providence, R. I., on such projects as improved gas masks. He was next sent to the company's tire division and for a time was in charge of tire development.

In 1931 the deceased was assigned to the Naugatuck Chemical Division and was appointed factory manager of the Division's main plant in Naugatuck. Five years later he became the Division's general sales manager and in 1939 was advanced to general manager of the Division. When the company formed a synthetic rubber division during World War II, Coe also headed this operation. He was elected a vice president of the company in December, 1945.

In 1953 he was named to handle the company's interests in the transfer of government-owned synthetic rubber plants to private industry. At this time he was relieved of his duties as general manager of Naugatuck Chemical. In December, 1954 when U. S. Rubber joined with Texaco, Inc., to form a synthetic rubber company, Texas-U.S. Chemical Co., Coe was elected its chairman of the board. He retired in 1955.

John Coe was born on December 15, 1889, in Rock Falls, Ill. After attending local grade schools and graduating from high school in Topeka, Kan., he entered the University of Kansas in 1907, then transferred to Washburn College, Topeka, from which he graduated in 1911 with an A.B. degree. He next studied chemical engineering at Massachusetts Institute of Technology and in 1913 received a B.S. degree.

Coe was honored by the Commercial Chemical Development Association in 1952 when he was selected as its "Man of the Year." The following year he received an honorary degree of Doctor of Science from Washburn College.

A widower, he is survived by a son and a daughter.

Armin G. Kessler

Armin G. Kessler, retired vice president and director of Farrel-Birmingham Co., Inc., Ansonia, Conn., died suddenly on May 30.

Kessler joined the Farrel organization in 1920 as general manager of the company's plant in Buffalo, N. Y., and was elected vice president and member of the board in 1923. For a period he was general works manager of all the company's plants and, in 1945, was appointed manager of sales of the Midwest district, with headquarters at Akron, O. His retirement from the company took place at the end of 1953, and in March, 1955, he also retired as director.

George J. Klein

George John Klein, since 1949 manager of rubber chemical sales, industrial chemicals division, in charge of the Akron, O., office, Pennsalt Chemicals Corp., Philadelphia, Pa., died on June 12 of a heart attack.

After his graduation from Purdue University in 1924 with a B.S. in Chemical Engineering, Mr. Klein joined National Lumber & Creosoting, Houston, Tex., as an assistant chemist. In the same year he became assistant to the manager of tire compounding at The B. F. Goodrich Co., Akron, O., where he remained until 1936. While there he also held the positions of manager of inter company relations and manager of raw materials inspection and development. From 1936 to 1947 he served as vice president and technical sales manager at Herron Bros. & Meyer, Akron.

George J. Klein

Mr. Klein was a member of the American Chemical Society and its Division of Rubber Chemistry and also belonged to several rubber groups including Akron, Southern Ohio, and Southern Rubber.

He was born on November 10, 1902.

The deceased is survived by his wife, a son, and two grandchildren.

Funeral services were held June 15 in Akron.

Herbert T. Dyett

Herbert T. Dyett, 85, retired former president and board chairman of Rome Cable Corp., died at his Rome, N. Y., home on May 8. A graduate of Cornell University, in 1897, Mr. Dyett founded the Rome Wire Co. in 1902. He served as president of General Cable Corp., when Rome Wire merged with others to form General in 1927, and resigned in 1933. In 1936 he helped found and became president of Rome Cable Corp. He became chairman in 1944 and served until his retirement in 1959.

He is survived by his wife, a son, and a daughter.

PLIOFLEX "C" cuts tire cost by seven cents or more!

A Goodyear exclusive—the incorporation of WING-STAY 100 in PLIOFLEX "C" rubbers during manufacture—can mean an antiozonant saving of ¾ cents per pound of rubber or at least seven cents per tire, depending on its size.

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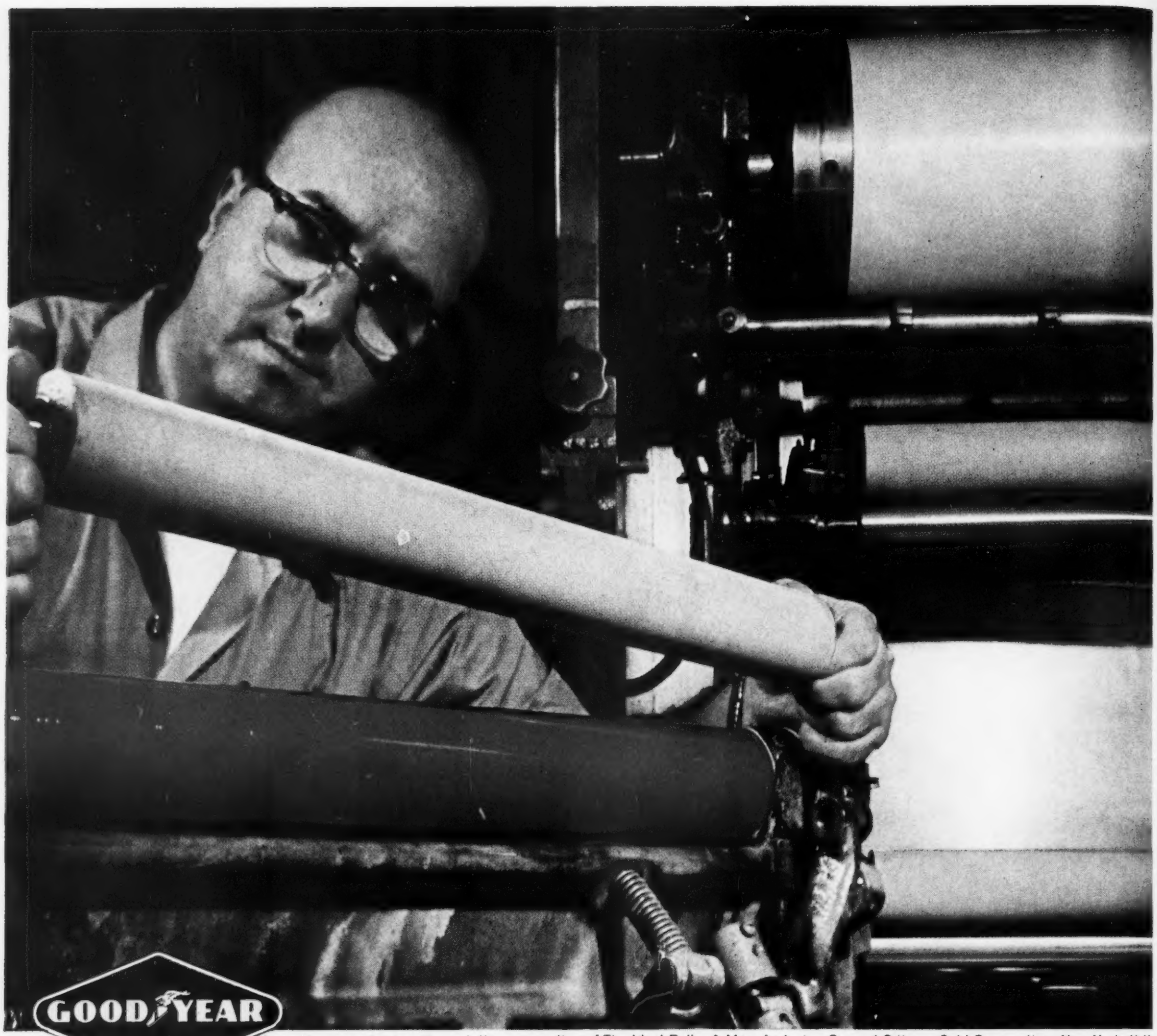

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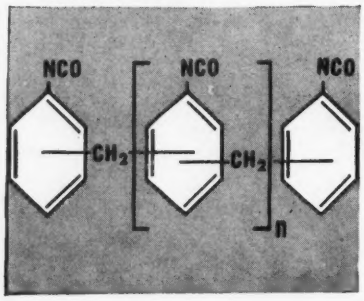

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CALENDAR of COMING EVENTS

June 12-September 1
Gordon Research Conferences. Colby Junior College, New London; New Hampton School, New Hampton; Kimball Union Academy, Meriden; and Tilton School, Tilton, all in N. H.

July 26-August 1
International Symposium on Macromolecular Chemistry. Queen Elizabeth Hotel, Montreal, P.Q., Canada.

August 3-4
Chemical Institute of Canada. Canadian Chemical Conference and Exhibition. Queen Elizabeth Hotel, Montreal, P.Q., Canada.

August 4
Division of Rubber Chemistry, Chemical Institute of Canada. Conference. Montreal, P.Q., Canada.

August 10
New York Rubber Group. Golf Outing. Scotch Plains and Echo Lake Country Clubs.

August 18
Philadelphia Rubber Group.

September 3-8
American Chemical Society. Chicago, Ill.

September 5-8
Division of Rubber Chemistry, ACS. Hotel Sherman, Chicago, Ill.

September 16
Connecticut Rubber Group. Outing.

September 29
Fort Wayne Rubber & Plastics Group.
Southern Ohio Rubber Group.

October 3
The Los Angeles Rubber Group, Inc.

October 5
Detroit Rubber & Plastics Group, Inc.

October 10
Buffalo Rubber Group. Hotel Westbrook, Buffalo, N. Y.

October 12
Northern California Rubber Group.

October 13
Boston Rubber Group. Hotel Somerset, Boston, Mass.
Philadelphia Rubber Group.

October 17
Elastomer & Plastics Group, Northeastern Section, ACS.

October 20
New York Rubber Group, Henry Hudson Hotel, New York, N. Y.
Akron Rubber Group. Sheraton-Mayflower Hotel, Akron, O.

November 2
Rhode Island Rubber Club.

November 3
Philadelphia Rubber Group.

November 7
The Los Angeles Rubber Group, Inc.

November 9
Northern California Rubber Group.

November 17
Connecticut Rubber Group.

November 17-18
Southern Rubber Group.

December 7
Fort Wayne Rubber & Plastics Group.

December 8
Detroit Rubber & Plastics Group, Inc.

December 9
Southern Ohio Rubber Group.

December 12
Buffalo Rubber Group. Christmas Party. Buffalo Trap & Field Club.

December 15
New York Rubber Group. Christmas Party. Henry Hudson Hotel, New York, N. Y.
Boston Rubber Group. Christmas Party. Hotel Somerset, Boston, Mass.

1962

January 26
Akron Rubber Group.

January 26-27
Southern Rubber Group.

February 5-9
American Society for Testing Materials. Committee Week. Statler Hilton Hotel, Dallas, Tex.

February 6
The Los Angeles Rubber Group, Inc.

February 8
Fort Wayne Rubber & Plastics Group.

March 6
The Los Angeles Rubber Group, Inc.

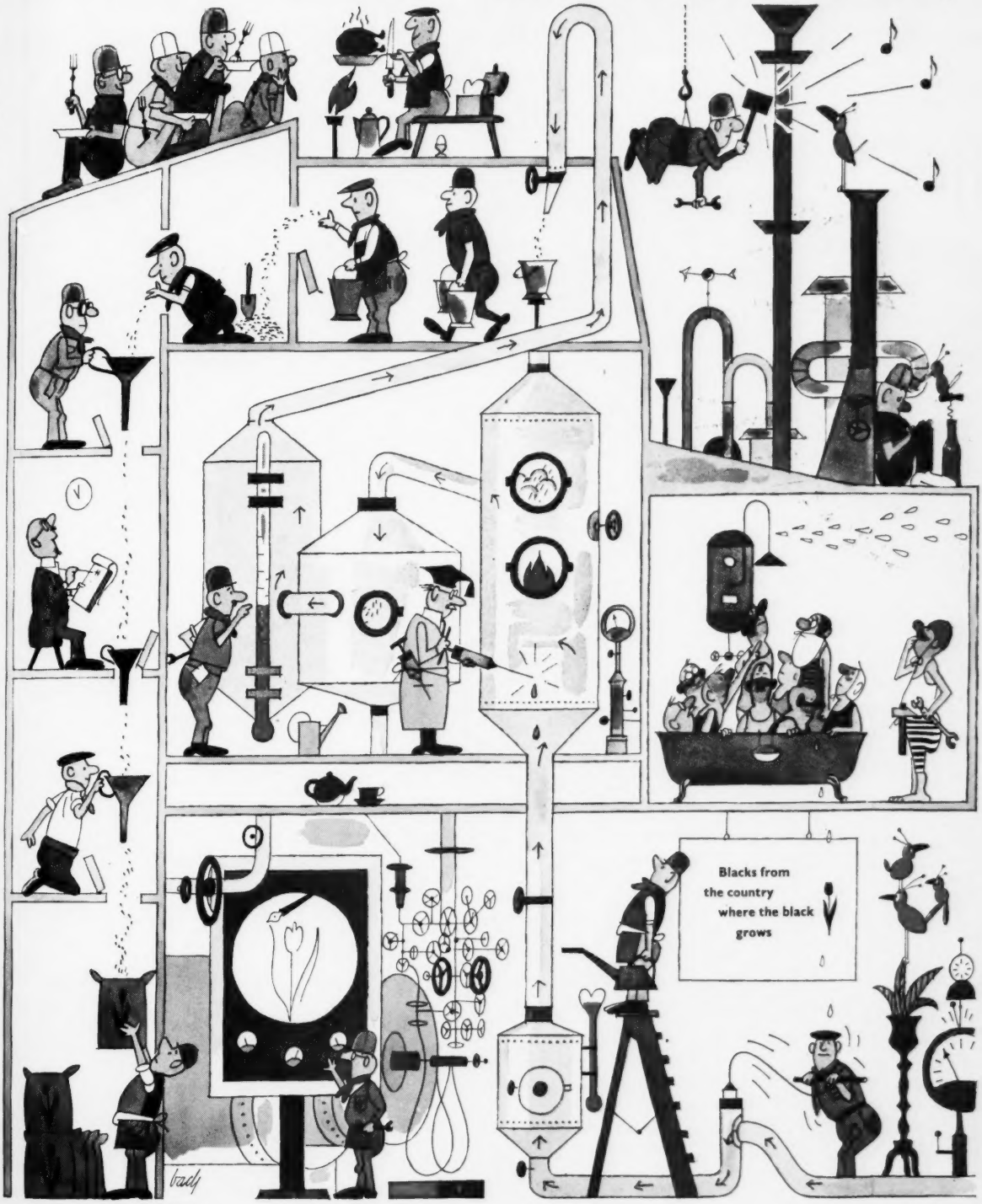
March 20-29
American Chemical Society, Washington, D. C.

March 23
New York Rubber Group. Henry Hudson Hotel, New York, N. Y.

April 3
The Los Angeles Rubber Group, Inc.

April 5
Fort Wayne Rubber & Plastics Group.

KETJEN CARBON's modern plant serves the rubber industry



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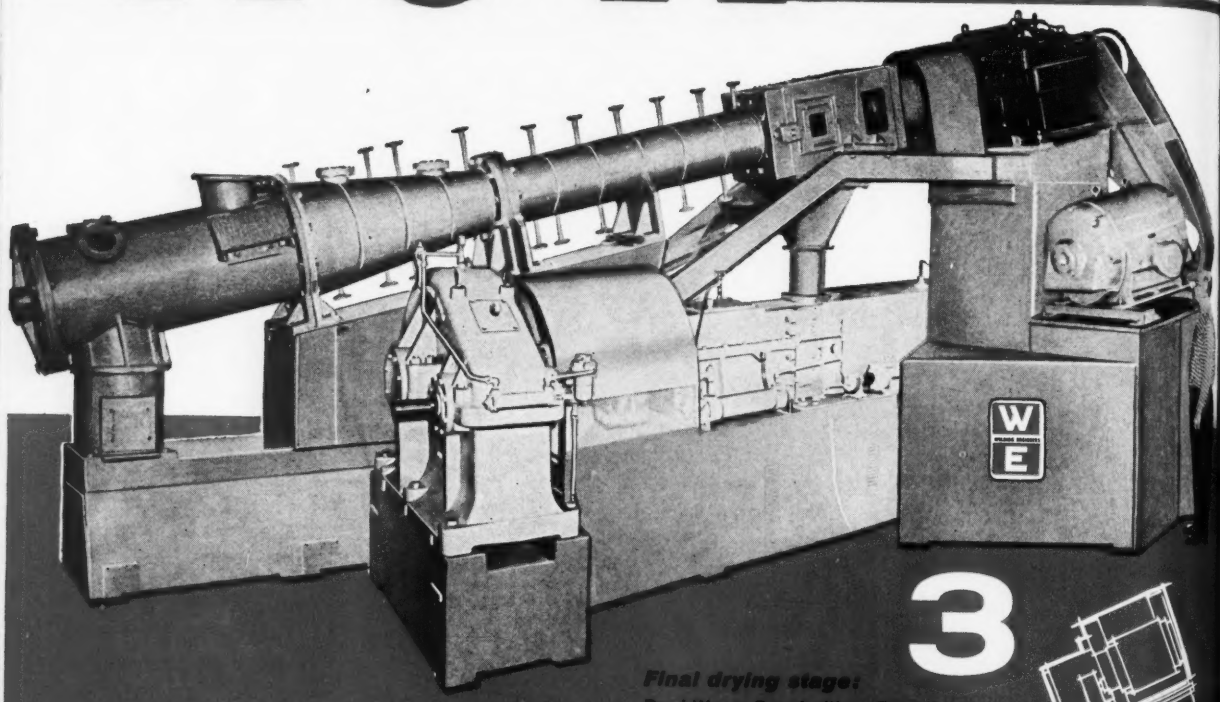
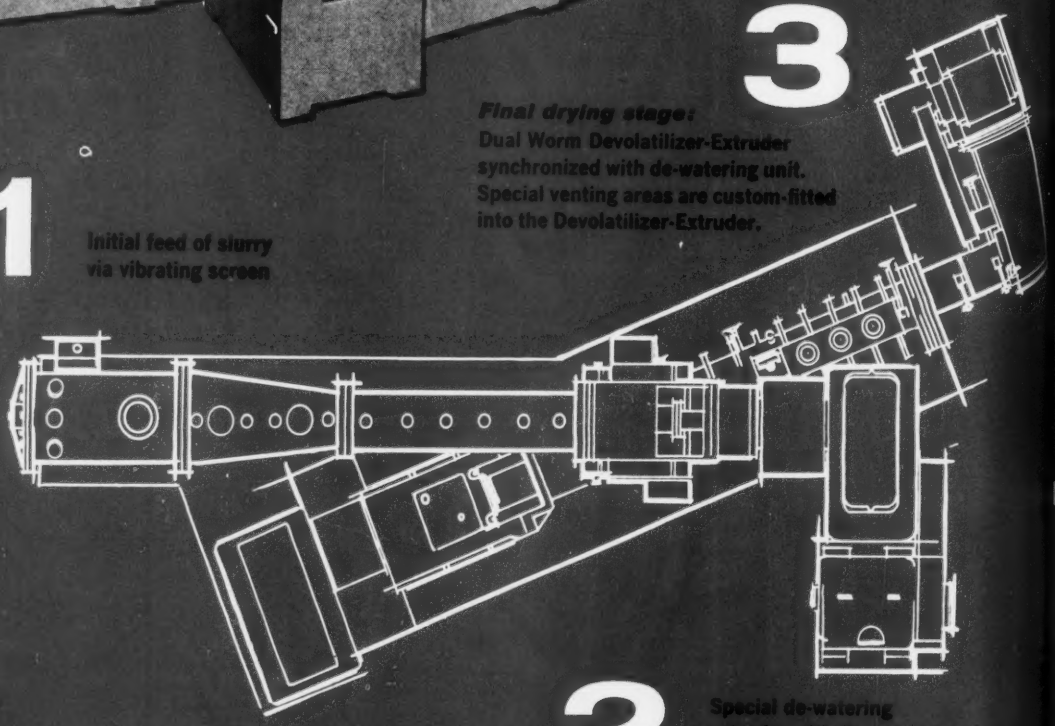


3

Final drying stage:
Dual Worm Devolatilizer-Extruder synchronized with de-watering unit. Special venting areas are custom-fitted into the Devolatilizer-Extruder.

1

Initial feed of slurry via vibrating screen



2

Special de-watering extruder with fines-free water draining feature

Welding Engineers Equipment is Expressly Designed for

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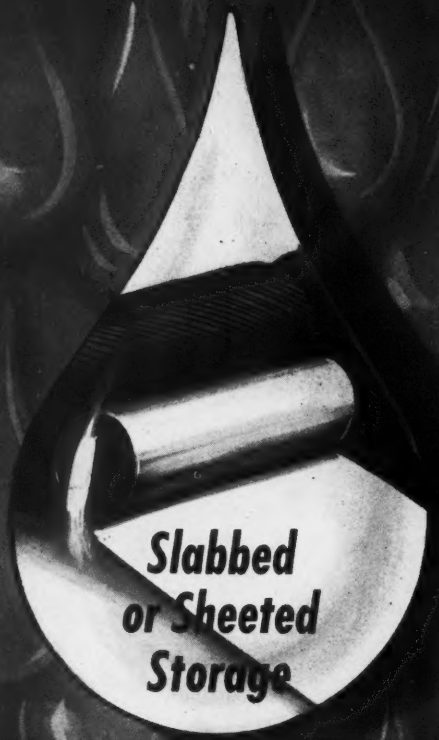
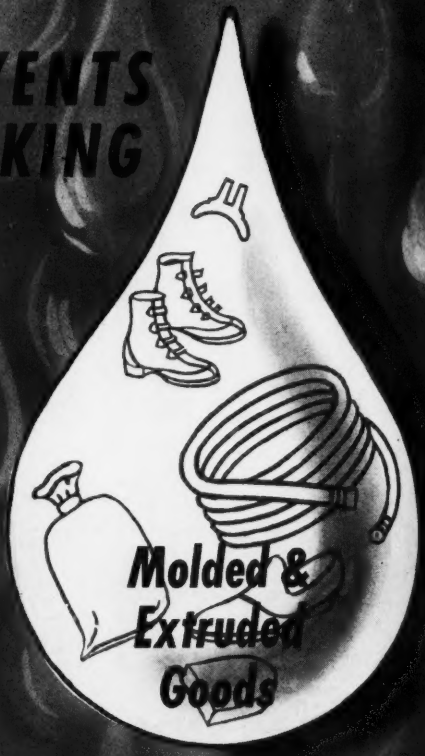
LUBRICANT

PREVENTS STICKING



A microscopic film of
GLYCERIZED LUBRICANT
(LIQUID CONCENTRATE)
You won't be able to see it on the rubber but you will know of its presence because of the non-adhesive properties it imparts. Does not interfere with tack or knit of stock.
ASK FOR SAMPLE



HIGHLY CONCENTRATED
1=50
1 DRUM MAKES UP TO 50 DRUMS OF WORKING SOLUTION

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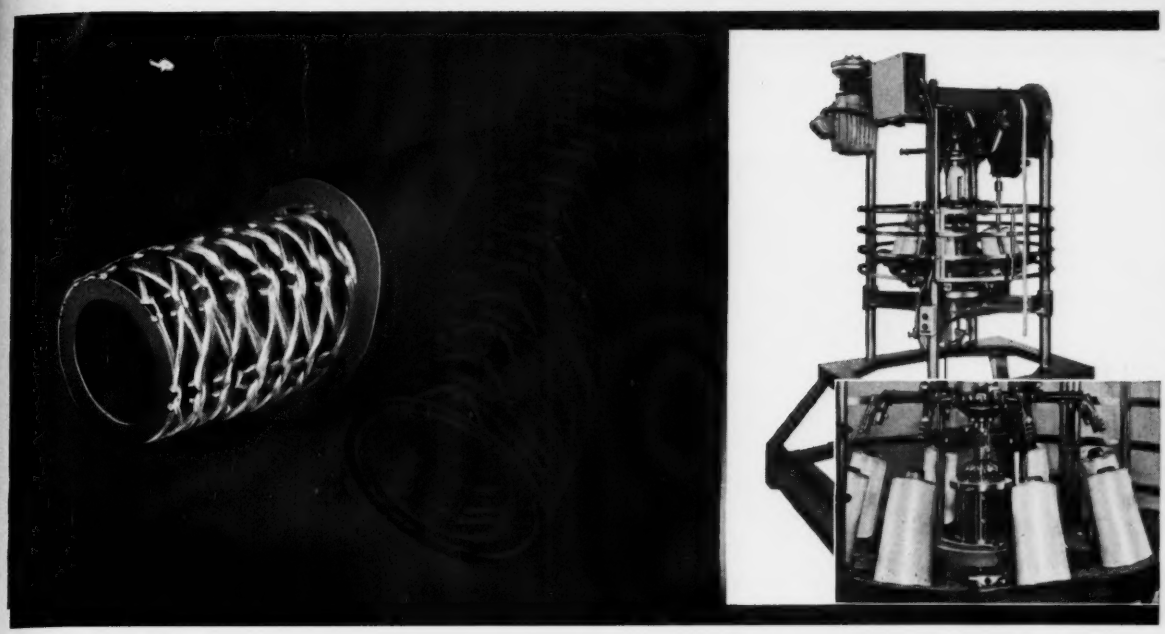
RUBBER MATERIALS DIVISION
West 48th Place and Whipple Street
CHICAGO 32, U.S.A.

Also Mfgrs. of RUBBEROL SYNTHIOL MICROLAN



New FIDELITY WRAP-KNIT
Saves Time, Saves Money, Adds Strength

You get these advantages only with the new Fidelity wrap-knit method of hose reinforcement. Use the Fidelity Hose Reinforcement Knitter with *all* natural or synthetic yarns . . . on rubber *or* plastic hose extrusions . . . with ID's from ⅛" to 2⅜". Load 64 lbs. of yarn *at one time* . . . complete up to a full day's production without *reloading*.

No other method of reinforcement offers the circumferential strength, resistance to swell and kinking — and *production economy* — as Fidelity Wrap-Knit. Write for details today . . . or come see a Fidelity in action!

YARN SAVINGS TO 35%

MAXIMUM BURST PROTECTION

SPEEDS TO 1,000 FEET/HOUR

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Through the years French rubber presses have proved their lasting rigidity, accuracy and unsurpassed economy of operation. Today's French patented features make them better than ever. Write us about your requirements and let us give you full details.

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THE FRENCH OIL MILL MACHINERY CO.
1000 Greene St., Piqua, Ohio

new materials

Dixon Corp., Bristol, R. I., is marketing its "Rulon" Spray in a new 16-ounce king-size aerosol can. (This release agent material was reported in RUBBER WORLD, January, 1961, page 32.)

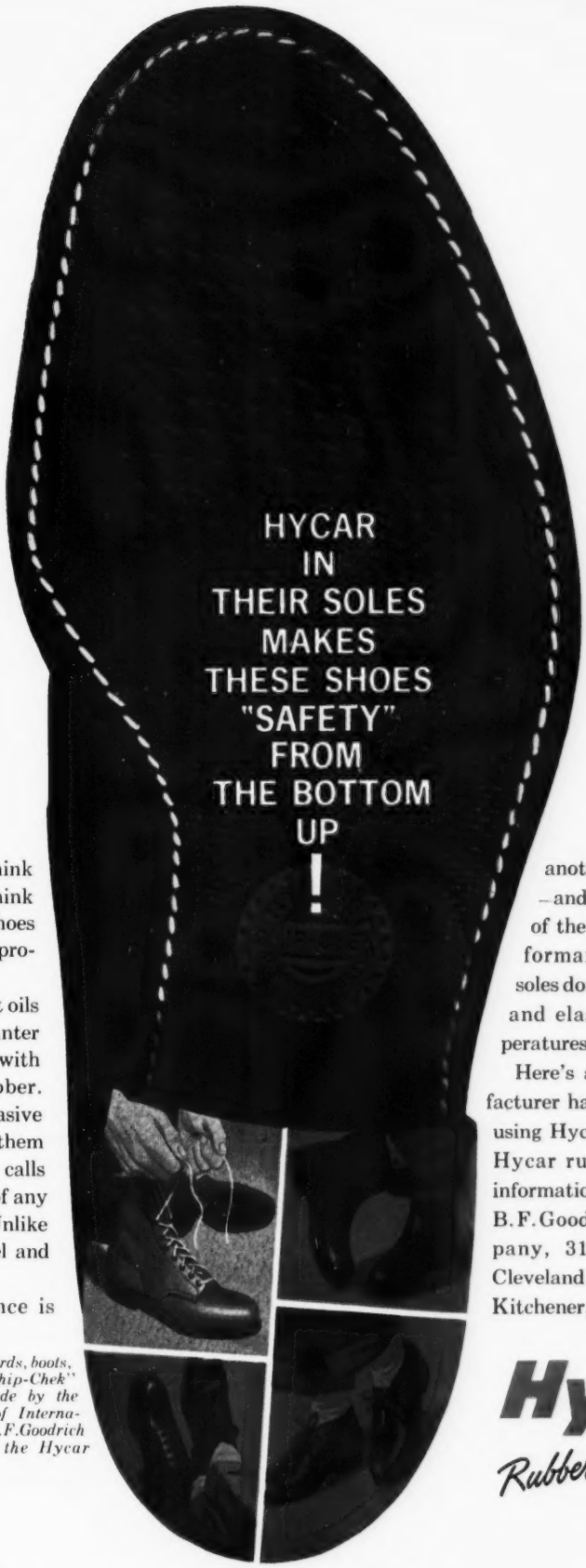
Pliolite Resin Latex

The Goodyear Tire & Rubber Co., chemical division, Akron, O., has introduced Pliolite Resin Latex 481-X, which was designed specifically for use as an air dry metal primer latex for paint applications. Still in the experimental stages, the new SBR resin latex is reported by the company to have the following properties: total solids, 55.4%; pH, 8.7; and Brookfield viscosity, 81 cps. Goodyear also states that the new material has excellent water and spray resistance.

Two New Catalysts

U. S. Peroxygen Corp., Richmond, Calif., has developed two new catalysts for high-temperature polymerization of various monomers and copolymers. The two new products, 2,5-dimethyl hexyl-2,5-diperbenzoate (USP 711) and 2,5-dimethyl hexyl-2,5-diperacetate (USP 811), have similar half-life characteristics to tertiary butyl perbenzoate and tertiary butyl peracetate, respectively, the manufacturer claims. It is further stated that the products also resemble these two catalysts in reactivity characteristics.

B.F.Goodrich



Ordinarily, when you think of "safety shoes," you think of toe protection. These shoes offer extraordinary sole protection as well.

For example, they resist oils a worker will likely encounter—because they are made with oil-resistant Hycar rubber. And addition of non-abrasive grit to the Hycar makes them what the manufacturer calls "the finest wearing soles of any material we've tried." Unlike most, these soles are steel and glass chips resistant.

Unusual slip-resistance is another wearer advantage—and safety factor. Because of the outstanding cold performance of Hycar, these soles don't lose their resilience and elasticity even at temperatures as low as −40°F.

Here's another way a manufacturer has improved a product using Hycar nitrile rubber. Can Hycar rubber help you? For information, write Dept. MA-1, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

These Hy-Test Safety Shoes—oxfords, boots, chukkas and bluchers—with "Chip-Chek" soles containing Hycar are made by the Hy-Test Safety Shoe Division of International Shoe Company, St. Louis. B.F.Goodrich Chemical Company supplies the Hycar nitrile rubber.

Hycar
Rubber and Latex

B.F.Goodrich Chemical Company

a division of The B.F.Goodrich Company

B.F.Goodrich

GOOD-RITE 2007

...a high-styrene resin for use with SBR and other rubbers

Good-rite 2007 is ideal for use in compounds for shoe soles, floor tiling, extrusions, rolls, golf ball covers and other high-durometer applications. It is available as a finely divided, easily blended, free-flowing odorless white powder. To learn more about how it can improve your product and simplify processing at the same time, write Dept. FB-3, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

FOR BETTER PROCESSING

- Improves mixing, calendering and extrusion characteristics when added to compounds.
- Easily handled; no masterbatching needed.
- Makes premium quality compounds in all ranges of hardness.
- Makes easy-to-extrude high-hardness compounds in a full range of colors.

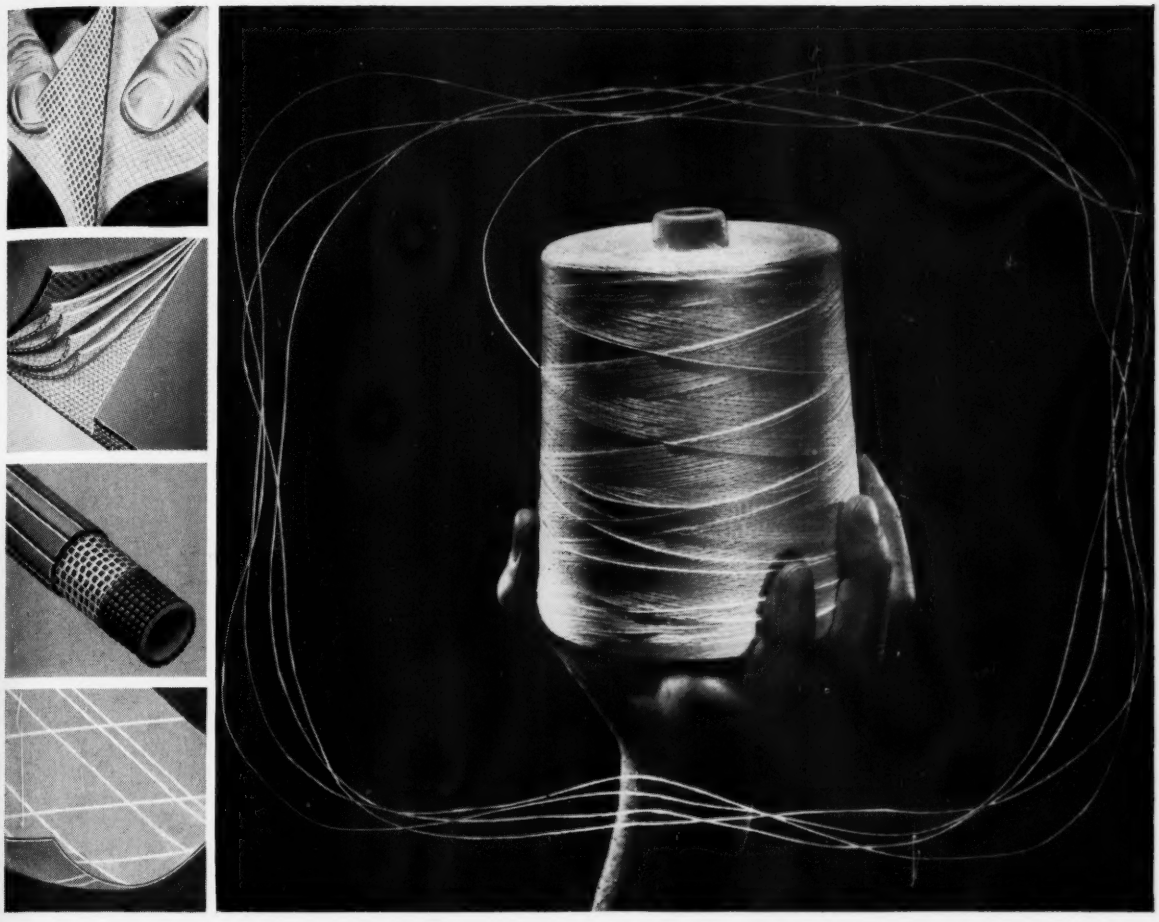
FOR BETTER PRODUCTS

- Superior flex life.
- Hardness without sacrificing strength.
- Improved abrasion resistance.
- Light weight.

Good-rite CHEMICALS
REG U S PAT OFF

B.F.Goodrich Chemical Company
a division of The B. F. Goodrich Company

An example of Avisco Rayons in Industry



Here's how industry adds muscle to reinforced paper, plastics and rubber.

There are many uses for laminated paper, plastics and rubber which require the addition of a high tensile reinforcement. One of the best is also one of the cheapest: Rayflex high strength filament. You'd pay 22% to 100% more for other fibers with comparable strength, impact and flex life.

Rayflex is the foundation for hose and belting, the basis of packaging tapes, the ideal filament for scrim fabrics that give paper, plastic and foil the economical extra strength they need in laminated constructions.

Avisco rayon can be engineered to meet specific reinforcing needs. Fabricators and users of products that require reinforcement have found that it pays to consult us. We'll be glad to study your problems.

QUICK REPLY COUPON 211

Industrial Merchandising Division
American Viscose Corporation
350 Fifth Avenue, New York 1, N.Y.

Please contact me about Avisco Fibers for reinforcing use in _____

Name _____

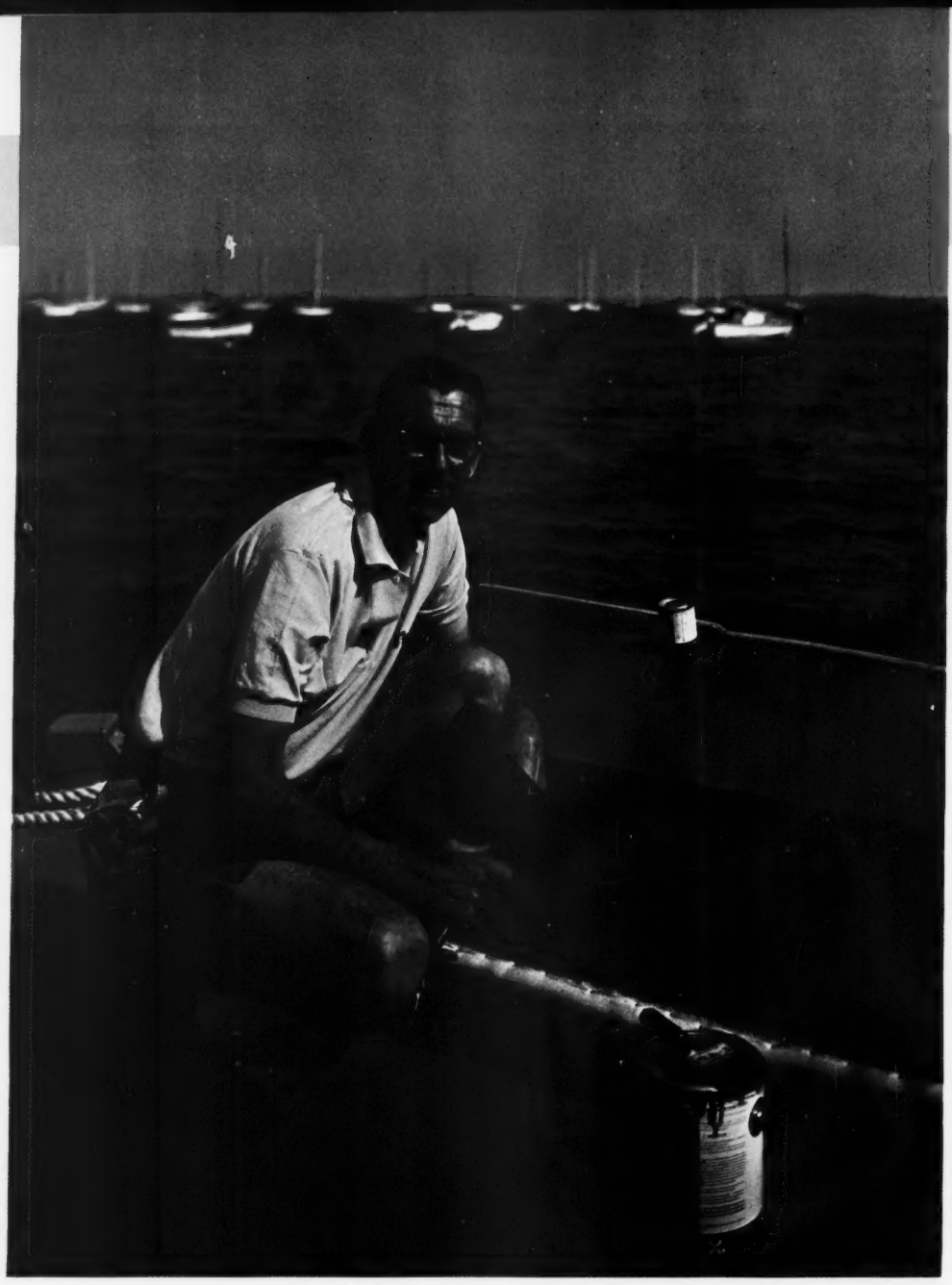
Company Name _____

Address _____

City _____ Zone ____ State _____

AVISCO® RAYON

AMERICAN VISCOSE CORPORATION, 350 Fifth Avenue, New York 1, N. Y.



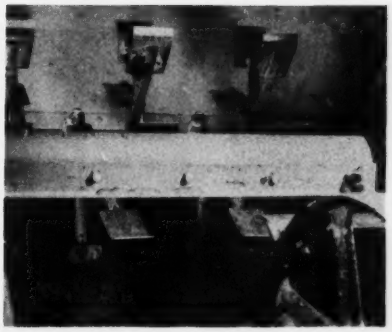
MEET ELIOT HOWARD— United Carbon district sales manager and an amateur yachtsman.

In boating, water is necessary—*outside the boat* but not in.

In manufacturing black masterbatch, eliminating the moisture is just as important.

ENSURANCE AGAINST MOISTURE

Drying—a function of time and temperature—is accomplished in this exclusive gas-fired drier *(the longest in the industry)* with temperature accuracy controlled to ± 1°F. BAYTOWN black masterbatch fully dried to the closest finishing tolerances in the industry assures customers of superior product performance.



Fully dried BAYTOWN black masterbatch as seen from the discharge end of the drier designed to the exclusive specifications of United Carbon. A series of stock breakers, similar to those shown here, within the multizoned drier turn the product over during the stepwise drying process to ensure optimum drying.

The new United-Barclay Process* has provided United Carbon with the means for producing the finest black masterbatch in the industry. Just one indication of the superiority of BAYTOWN black masterbatches is their consistently lower moisture content. In fact, these products have fewer impurities of all kinds.

The elimination of salt and other highly water soluble impurities found in brine is one of the most important advantages of the new process. In addition, the process affords proper control of coagulum and a reduction in fines which cause an obstruction in air circulation preventing the escape of volatiles during drying.

With the virtual elimination of impurities and moisture plus unique "wet" mixing, United Carbon consistently brings you the high-quality masterbatches you need.

*Patents Applied For

BAYTOWN—The Birthplace of Black Masterbatch

For more information on the low moisture content of BAYTOWN black masterbatch, contact:

UNITED CARBON COMPANY, INC.
410 PARK AVENUE, NEW YORK 22, N. Y.
A Subsidiary of United Carbon Company
AKRON CHICAGO LOS ANGELES
BOSTON HOUSTON MEMPHIS
In Canada: CANADIAN INDUSTRIES LIMITED
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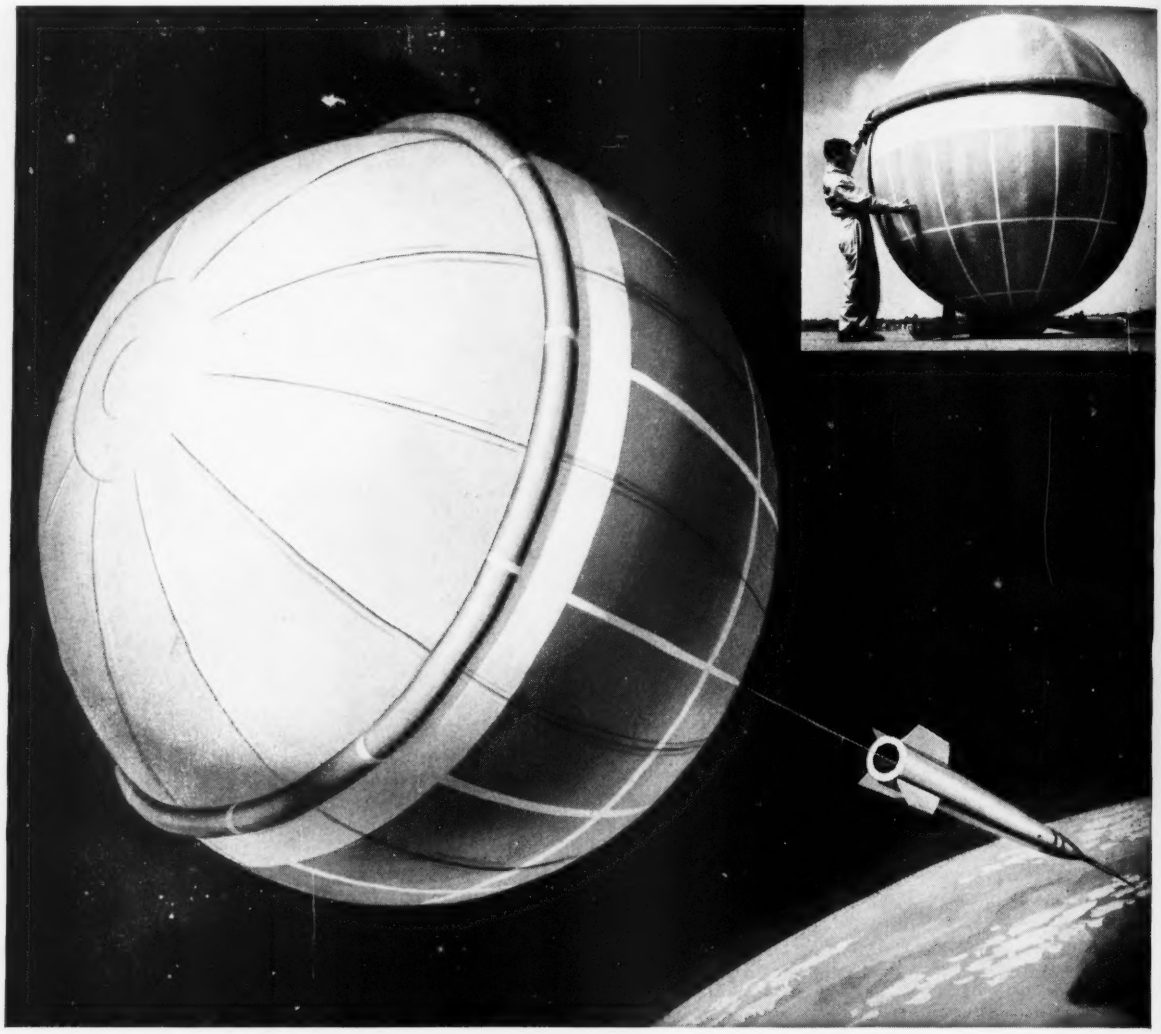
UNITED CARBON

Fabric balloon "puts the brakes" on space vehicles returning to earth



Slowing vehicles in orbit to provide safe passage down through the "heat barrier" of the upper atmosphere is one of the knottiest problems of space travel. One ingenious solution is the drag balloon developed by the Goodyear Aircraft Corporation.

Called "Ballute," this high-altitude recovery system consists of a nine-foot fabric balloon which pops out of a capsule's tail section—and automatically inflates in one-tenth second. After halting the vehicle's "tumbling" motion, it is reeled out by steel cable to the point of maximum drag. At lower altitudes, a parachute is ejected to complete recovery.

Fabrics used in these balloons must withstand the severest strain. And a Wellington Sears synthetic fiber fabric, with a protective coating on the surface, has been successfully used to slow down 500-lb. experimental capsules traveling twice the speed of sound at 150,000 feet!

Engineering industrial textiles for specialized technological needs is a century-old tradition with Wellington Sears. We've worked with development engineers in almost every field. And all this experience is yours to draw on. Write for assistance—and our illustrated booklet, "Fabrics Plus," Dept. H-7.

WELLINGTON SEARS

WEST POINT TEXTILES

FIRST in Fabrics for Industry

For mechanical goods, coated materials, tires, footwear and other rubber products

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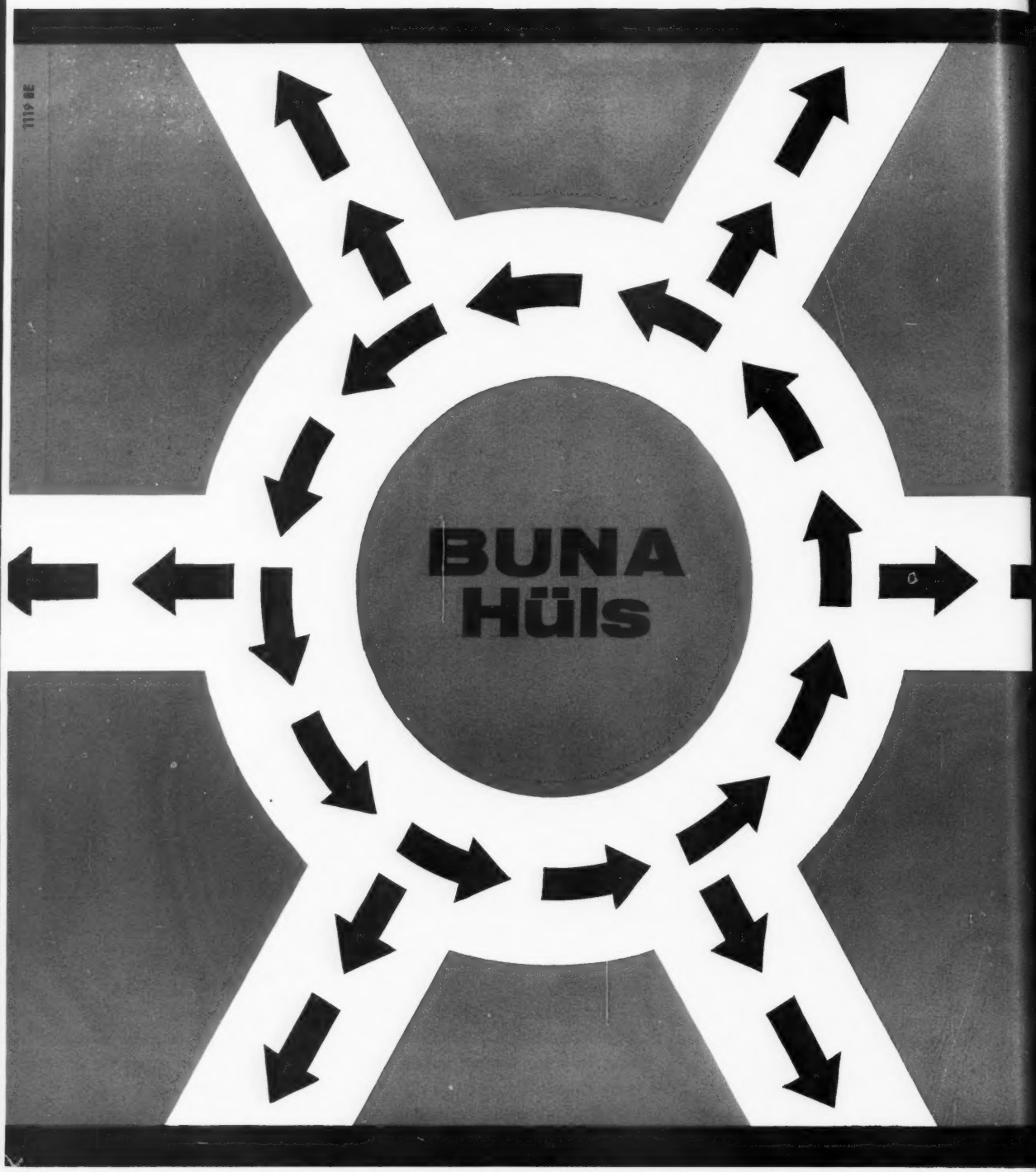
(AP Wirephoto)

In a field of thoroughbreds, there's little to choose between the winner and the also-ran as they thunder down the homestretch. In the rubber industry, it's the same way. Marbon Chemical, the pioneer-leader in high styrene rubber reinforcing resins, gives you that little extra that makes the big difference. Important extras like a consistent high level of performance through rigid quality control, unsurpassed technical assistance, complete research and development facilities, total reliability and faster service through same-day shipments. Don't be satisfied with place or show. Put your money on a proven winner who has led the field right from the start—Marbon Chemical!

Get all the facts about Marbon high-styrene rubber reinforcing resins for shoe soles, floor tile, wire and cable, hard rubber and mechanical goods. Write Dept. W-7.

MARBON CHEMICAL DIVISION **BORG-WARNER**
WASHINGTON WEST VIRGINIA



The right grade of BUNA Hüls for every application

Seven standard grades, eight special grades and two types of latex – these comprise the BUNA Hüls range. The right material for every application. Every grade is correctly formulated and quality never varies.

Round-the-clock production at Bunawerke Hüls, coupled with adequate stocks ensure prompt delivery. This reduces storage costs for the processer.

Ju

STANDARD GRADES

BUNA Hüls 150
HS, staining
General purpose type, specially suited for manufacture of tyres, conveyor belting, high quality shoe soles, technical mouldings and special items.

BUNA Hüls 152
HS, non-staining
General purpose type for the manufacture of light coloured rubber goods and high quality shoe soles.

BUNA Hüls 153
HS/FS, non-staining
Specially developed for the production of very light coloured and transparent rubber goods and cable insulation.

BUNA Hüls 302
HS, staining, with 37.5 parts oil
Recommended for tyres, retreading, technical mouldings.

BUNA Hüls 362
HS/FS, non-staining, with 37.5 parts oil
Light coloured and transparent grade with good processing characteristics on roll mill and calender; reduced tackiness during processing.

BUNA Hüls 372
HS, non-staining, with 37.5 parts oil
Excellent properties, specially suited for production of light coloured and transparent articles, white walled tyres.

BUNA Hüls 373
HS, non-staining, with 50 parts oil
For the economical production of moulded rubber goods of all types; raw material cost reduced.

SPECIAL GRADES

BUNA Hüls BT 13
HS/FS, equivalent to BUNA Hüls 373

BUNA Hüls BT 21
HS/FS, equivalent to BUNA Hüls 302
The advantage of these two grades is that there is reduced tackiness when processing raw mixes on roll mills.

Types with high Mooney values

BUNA Hüls BT 4
HS, staining; Mooney viscosity (ML_4) approx. 120

BUNA Hüls BT 22
HS/FS, equivalent to BT 4

BUNA Hüls BT 12
HS, non-staining, Mooney viscosity (ML_4) approx. 150
These grades are especially suitable for the production of heat resistant articles, e. g. high pressure gasketing, brake and clutch linings as well as for flame resistant rubber mixes with high chlorparaffin content; extremely low compression set in the case of grade BT 12; processability of BT 15 better than that of BT 12.

BUNA Hüls BT 15
HS, non-staining, Mooney viscosity (ML_4) approx. 130

Types with low Mooney values

BUNA Hüls BT 16
HS/FS, non-staining, Mooney viscosity (ML_4) approx. 40

BUNA Hüls BT 17
HS/FS, non-staining, Mooney viscosity (ML_4) approx. 30
These grades are distinguished by the ease with which they take up fillers, better calendering properties and less shrinkage. Designed for the production of soft, easy flow rubber mixes (e. g. for rubber soles made by moulding direct to uppers); also for sponge rubber.

LATICES

BUNA Hüls 200
HS, staining

BUNA Hüls 220
HS, unstabilised
Used for impregnation of fabrics and tyres cord, also for coating purposes.

HS: rosin acid, FS: fatty acid

BUNA is a registered trademark

You can rely on BUNA Hüls
BUNAWERKE HÜLS GMBH · MARL · KREIS RECKLINGHAUSEN
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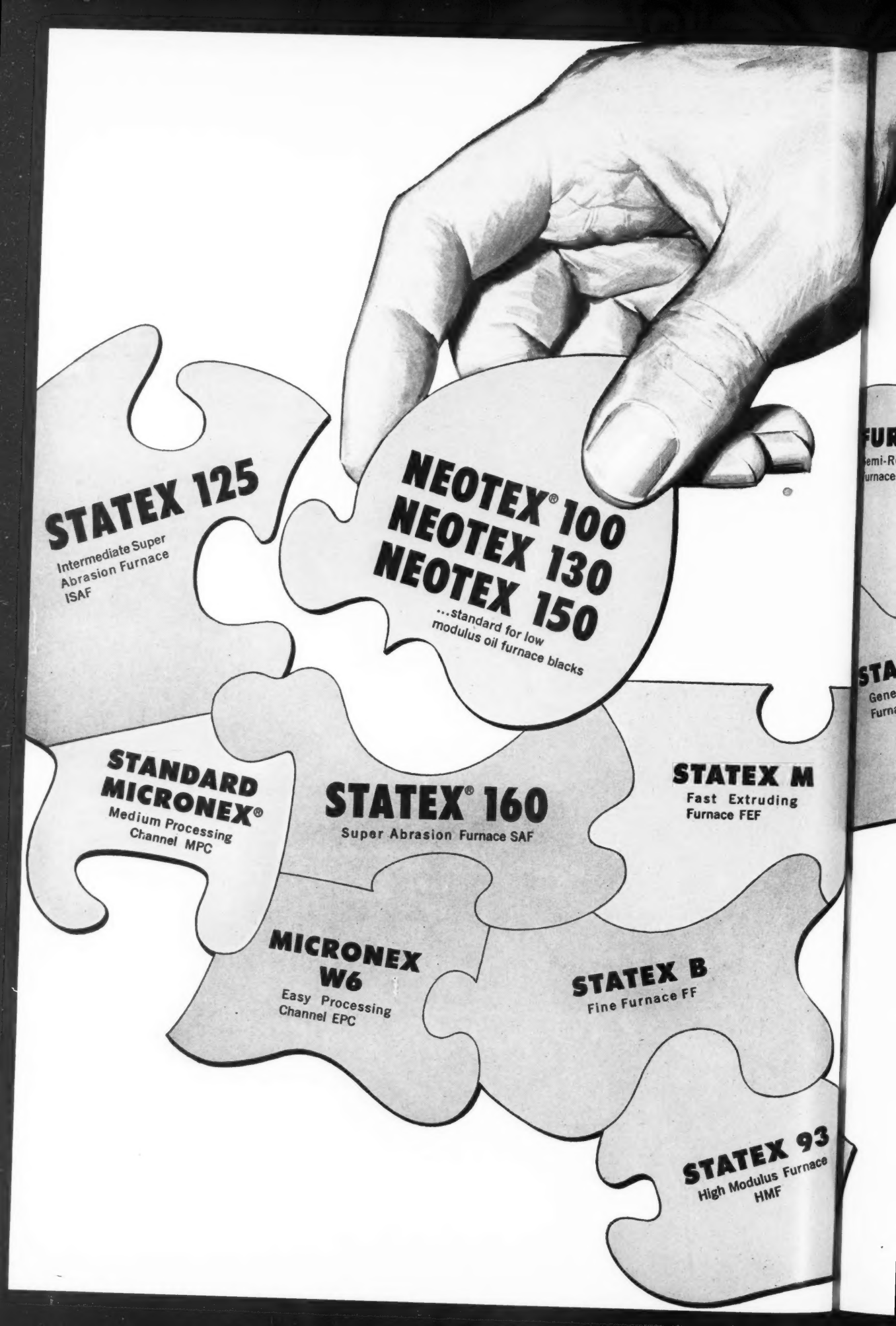
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Fast Extruding Furnace FEF
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COLUMBIAN has a carbon black to fit your every rubber need!

From the outstanding blacks of the STATEX range to the new NEOTEX blacks — those oil furnace carbon blacks that provide a softer ride, less noise, good wear — Columbian has a carbon black for every use. Contact your Columbian representative . . . and send off the coupon for complete information, today.

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about Columbian carbon blacks for rubber!

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Nevillac® makes adhesives more tenacious

Prominent among the attributes which make Nevillac, Neville Chemical Company's line of hydroxy resins, a valuable addition to adhesive formulation is its inherent tackifying ability. When correctly compounded, it improves surface adhesion, promotes quick initial grab and improves bond strength. It literally makes adhesives more tenacious.

But there are other excellent reasons for including the Nevillac resins in your formulations. They are so highly compatible and soluble with a host of other materials that they act as an agent in bringing together other materials which are normally incompatible. This co-compatibilizing and natural solubilizing ability pertains to their use with most elastomers, plasticizers, and other resins. The Nevillac resins can lower the molten viscosity of many adhesive formulations and accentuate resistance to water, acids and alkali. They also possess generally good light stability, permanent thermoplasticity and ease of emulsification. If you formulate cold cut, hot melt, or latex blended adhesives, it will pay you to investigate further. Write for Technical Service Bulletins Number 72 and 75.

Neville Chemical Company, Pittsburgh 25, Pa.

NEVILLE®

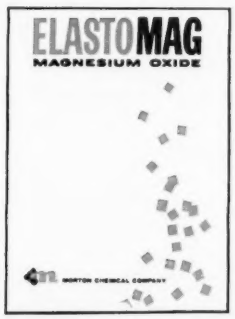
Neville Products

Resins—Coumarone-Indene, Hydrocarbon (Thermoplastic and Heat Reactive), Hydroxy • **Oils**—Plasticizing, Neutral, Rubber Reclaiming, Shingle Stain • **Solvents**—Aromatic (Refined and Crude), Semi-Aromatic (Refined and Crude). • **Antioxidants**—Non-Staining Rubber • **High Purity Indene • Indene Derivatives • Crude Naphthalene.**

ELASTOMAG
MAGNESIUM OXIDE

Three activity grades give you ideal process safety for every type of recipe

Cut down on costly throw-away loss caused by scorch. Get better bin stability . . . better states of cure by using an *activity-controlled* ELASTOMAG oxide from Morton. Three precision activity grades of ELASTOMAG—170 (high), 100 (medium), and 20 (low)—let you choose the oxide with a Morton Activity Index (MAI) that's ideal for every stock. New ELASTOMAG Micro-Pellets eliminate dusting problems. No binder or treating agent is used. In the mixer, Micro-Pellets break down to minute particles . . . provide the same superior dispersion as ELASTOMAG in the powdered form.



Get new ELASTOMAG Bulletin that summarizes tests on Neoprenes, Hypalon, and Fluoroelastomers. See how you can increase production with a new ELASTOMAG oxide. Ask your Morton Man for a copy now. Phone or write distributors below.

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Photo courtesy of Chicago Rawhide Company

new products

Fusible tape made of K-1628 compound is being machine wrapped on to a stator coil

High Modulus Silicone

A new fusible silicone rubber compound designed for fabricating electrical insulating tapes has been developed by Union Carbide Corp., silicones division, New York, N. Y.

Designated K-1628, the new material offers advantages to both manufacturers and users of insulating tapes, the company states. A major advantage for consumers is its high modulus—110 psi, at 100% elongation—which makes it possible to apply tape by machine wrapping and which prevents overstretching to insure greater uniformity during coil wrapping, thus providing better insulation, the manufacturer further reports.

Union Carbide says that tape fabricators benefit from the fact that K-1628 is preconditioned for almost immediate use, which reduces to a minimum the need of plasticizing. Easier to handle, the compound has high green strength, which permits increases in extrusion rates and manufacturing output by as much as 100% over other available fusible compounds.

High-Traction V-Belt

B. F. Goodrich Industrial Products Co., Akron, O., has developed a high-traction, low-strength V-belt which powers the wheels on many large tandem tractors. The new belt links the powered axle of the truck to the unpowered axle, transforming the free-rolling wheel into a driven wheel, with all the advantages of a tandem-drive differential, but at a fraction of the cost, according to the Goodrich company.

V-belt powers tractor wheels

Goodrich, who will market the new V-belt through Dayton (Sterkel) Tandem V-Belt Drive Co., Denver, Colo., claims its advantages include: better traction in all weather conditions; smoother, safer, more uniform power and brakes; safer downhill traction; improved tire mileage; lower cost per mile compared with tandem axle drive; and smoother riding —belt acts as shock absorber between axles, thus lessening shock to the gears, the axle shafts, and the clutch.

New Premium Tire

Goodyear Tire & Rubber Co., Akron, O., is marketing a new "Double Eagle" premium tire, with larger nylon cord, which is designed for use with an independently inflated inner shield, providing the safety of a tire within a tire and virtually eliminating the roadside flat, the Goodyear company says.

Stressing the strength of the nylon tire cord, Goodyear reports that one strand is capable of supporting the entire weight of the four-ply tire, which contains more than 4,000 strands. The tire carries a 36-month guarantee against all normal road hazards.

(Continued on page 44)

Strong Restraining Influences...

Roebling Hose Reinforcing Wire

Roebling Hose Wire, Hose Reinforcing Wire and Hose Wrapping Wire bear the stamp of Roebling's strict attention to constant uniformity. As with all Roebling wire products, each is wholly Roebling-made and Roebling-controlled, from open hearth to packaging. Tensile strength and forming qualities, finish and gage are of an excellence that proves itself in use.

Resistance to internal and external pressures and wear are what you look for in hose wires and what you pay for. With Roebling, you *get* them.

For further information on these and other Roebling quality products, write or call Roebling's, Wire and Cold Rolled Steel Products Division, Trenton 2, New Jersey.

Roebling... Your Product is better for it

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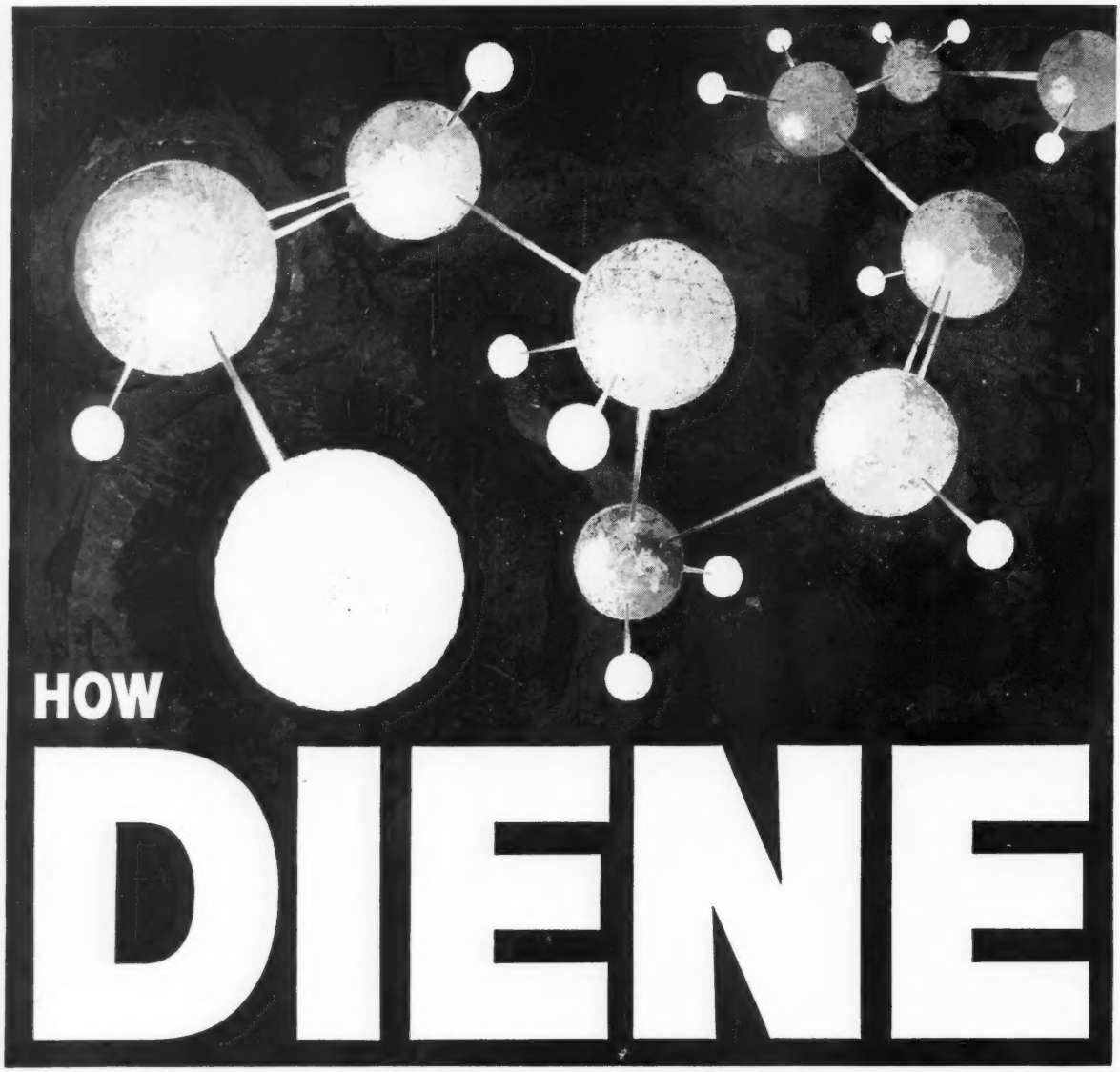

HOW DIENE

UNLEASHES NEW FORCES IN THE RUBBER MOLECULE

Before Diene*, when you added any given polymer to rubber it was like adding 2 + 2. The result was always 4.

That's why Firestone's dynamic new Diene is so significant. Many chemists and compounders are finding that rubber and Diene are making 2 + 2 = 5!

They're finding that Diene rubber, when mixed in major proportions with natural rubber or Styrene-Butadiene rubber, lends remarkable new qualities to the resultant compound. Qualities that expand and excel the best features of both, synergistically. Such payoffs as 20% more resiliency than natural rubber, for example, and greater resistance to wear, heat, cracking and aging all result.

Diene unleashes new forces in the rubber molecule and uncovers new potentials for rubber products!

Take truck tires as an example. Multi-million-mile road tests involving tires with Diene-natural rubber compounds have shown greater wear resistance. Lower operating temperatures. Improved road grip on slick surfaces. Better gas mileage through reduced rolling resistance.

Moreover, Diene will improve many *other* rubber products—from rubber soles to conveyor belts.

You'll want to learn more about this outstanding research achievement. Write for development quantities and technical information to: Dept. 21-3, Firestone Synthetic Rubber and Latex Co., Akron 1, Ohio.

Firestone's Diene rubber plant is in full commercial production.

Firestone

SYNTHETIC RUBBER & LATEX CO.

AKRON 1, OHIO

FR-S

MAKING THE BEST TODAY STILL BETTER TOMORROW

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*A Firestone trademark for synthetic rubber

Call Hall

HALLCO NEWS

Issued by
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Chemical Manufacturers

No. 16

HALLCO C-566 SOFTENS, SMOOTHS BOTH NATURAL AND SYNTHETIC RUBBERS

As a plasticizing agent, Hallco C-566 is highly recommended for use in the processing of all types of natural, synthetic or reclaimed rubber. It is a superior break-down ingredient and aids in the dispersion of carbon black and other additives. This Hallco plasticizer will help obtain smoother tubing, finer extrusions and calendering. Used in amounts ranging from 1 to 10 parts it also tends to reduce scorch to a minimum. Hallco C-566 is a clear, oily, amber liquid of petroleum origin. This plasticizer is manufactured by The C. P. Hall Company and is available in drums or tank cars.

IMPROVE TENSILE ON YOUR BUTYL RECLAIM

Preliminary tests and reports from users indicate that our 4039-Y Reclaiming Oil improves tensile on butyl reclaim. The resulting stocks show easier processing characteristics and higher physical properties than can be expected from other reclaiming oils.

Further tests indicate that it is ideal for both scorched scrap and partly "set-up" stocks. A reduction in processing time and cost was also noted when 4039-Y was used in the reclamation of regular rubber. As little as 5% 4039-Y has completely reconditioned scorched Neoprene, according to manufacturers' and processors' reports. Stocks treated with it can be worked back into the original stock or used as a workaway in other stocks. 4039-Y is manufactured by The C. P. Hall Company.

P.S. Use our "Maglite® D" in your Neoprene batches and avoid scorching entirely!

The C. P. Hall Co.
CHEMICAL MANUFACTURERS

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Copolymer RESEARCH HELPS YOU ACHIEVE GREATER PRODUCT QUALITY

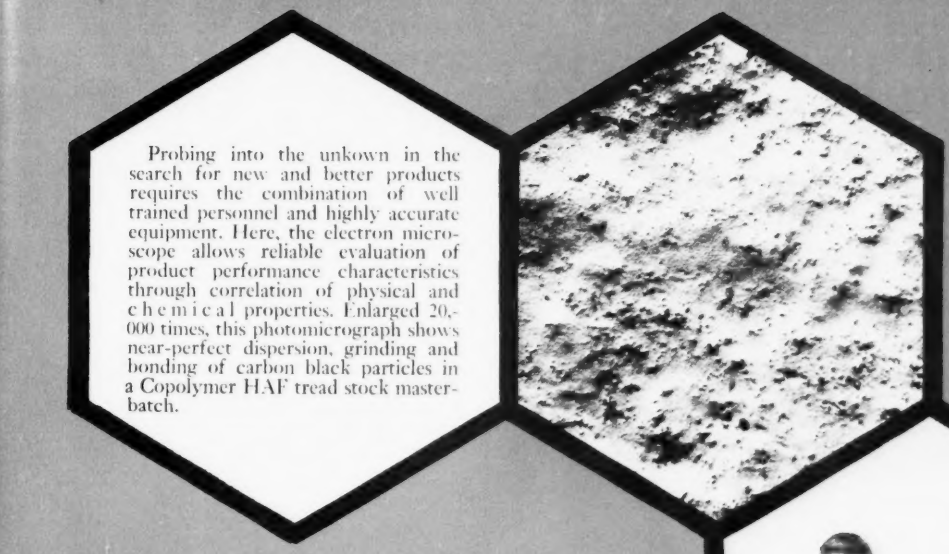
AND THIS MAN KNOWS WHY!

He's DR. RAY L. SCHULTZ, Director of Research and Development at Copolymer . . . and he knows that customers look to Copolymer for leadership in providing them with superior products and more efficient technical services.

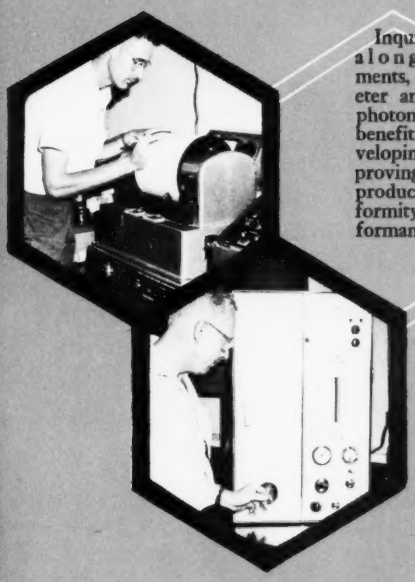
RAY and his staff couple creative thinking with the most modern equipment to investigate every possibility which may yield new products or result in additional customer benefits.

He's a Harvard man with a PhD and years of training and experience . . . part of Copolymer's program of dedicated exploration . . . helping customers to achieve greater product quality and uniformity, more economically!

Probing into the unkown in the search for new and better products requires the combination of well trained personnel and highly accurate equipment. Here, the electron microscope allows reliable evaluation of product performance characteristics through correlation of physical and chemical properties. Enlarged 20,000 times, this photomicrograph shows near-perfect dispersion, grinding and bonding of carbon black particles in a Copolymer HAF tread stock masterbatch.



Inquiring, imaginative minds along with precision instruments, like the vapor fractometer and the infrared spectrophotometer, are always at work benefiting customers . . . . developing new products and improving the quality of existing products to yield greater uniformity and consistency of performance.



Your Copolymer representative can help you select the right rubber for your manufacturing needs. Call him soon!

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RUBBER & CHEMICAL CORPORATION

Phone: Elgin 5-5655 P. O. Box 2591, Baton Rouge, Louisiana

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Part Three—NATURAL AND SYNTHETIC RUBBERS, LATICES, AND RECLAIMS

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the big news story for suppliers and users of elasto-plastic components!

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Now Permits Mass Production of Urethane Elastomer Parts by Low-Cost Injection and Transfer Molding or Extrusion

TEXIN, a newly-developed urethane elastomer "green stock" resin supplied in chopped particle form, is designed for those mass market industrial applications which require a highly-functional elasto-plastic material that can be simply processed with existing equipment by fast-cycle, low-cost methods.

TEXIN by-passes the costly, time-consuming liquid casting system formerly required in processing cured urethane elastomer items. Yet, it gives you the immediate market advantage of a thoroughly field-tested material, with properties identical to cast Multrathane® elastomers, while reducing part-forming time from hours to a matter of seconds.

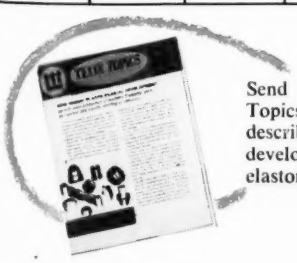
TEXIN is specially formulated for heavy-duty applications which demand the unusual combination of wear resistance, hardness, elasticity, and high impact and mechanical strengths — particularly in original equipment components having difficult design features such as undercuts, slots, tapers, gear teeth, inserts and threads subject to high abrasive wear or oil immersion. Literally hundreds of these applications, many not adaptable to casting methods, are 'right' for molded urethane elastomer. TEXIN can bring them in.

The markets for urethane elastomer items are already well developed and waiting to hook into your production line. For full details and technical assistance, write immediately to Mobay Chemical Company, Code RW-1, Pittsburgh 5, Pa.

e-8

Typical minimum physical properties of two grades of TEXIN

Type	Specific Gravity	Bulk Factor	Hardness		Tensile Strength	Elongation at break	Tensile Modulus psi			Elongation Set	Tear Strength
			Shore A	Shore D			100%	200%	300%		
192 A Molding Grade	1.25	2.7	92–94	44–45	4400 psi	600%	1150	1550	2050	45%	300 lbs.
280 A Extrusion Grade	1.25	2.7	80	—	5500 psi	600%	650	900	1500	30%	—



Send for your copy of Texin Topics, an illustrated bulletin describing the latest application developments in the urethane elastomer field.

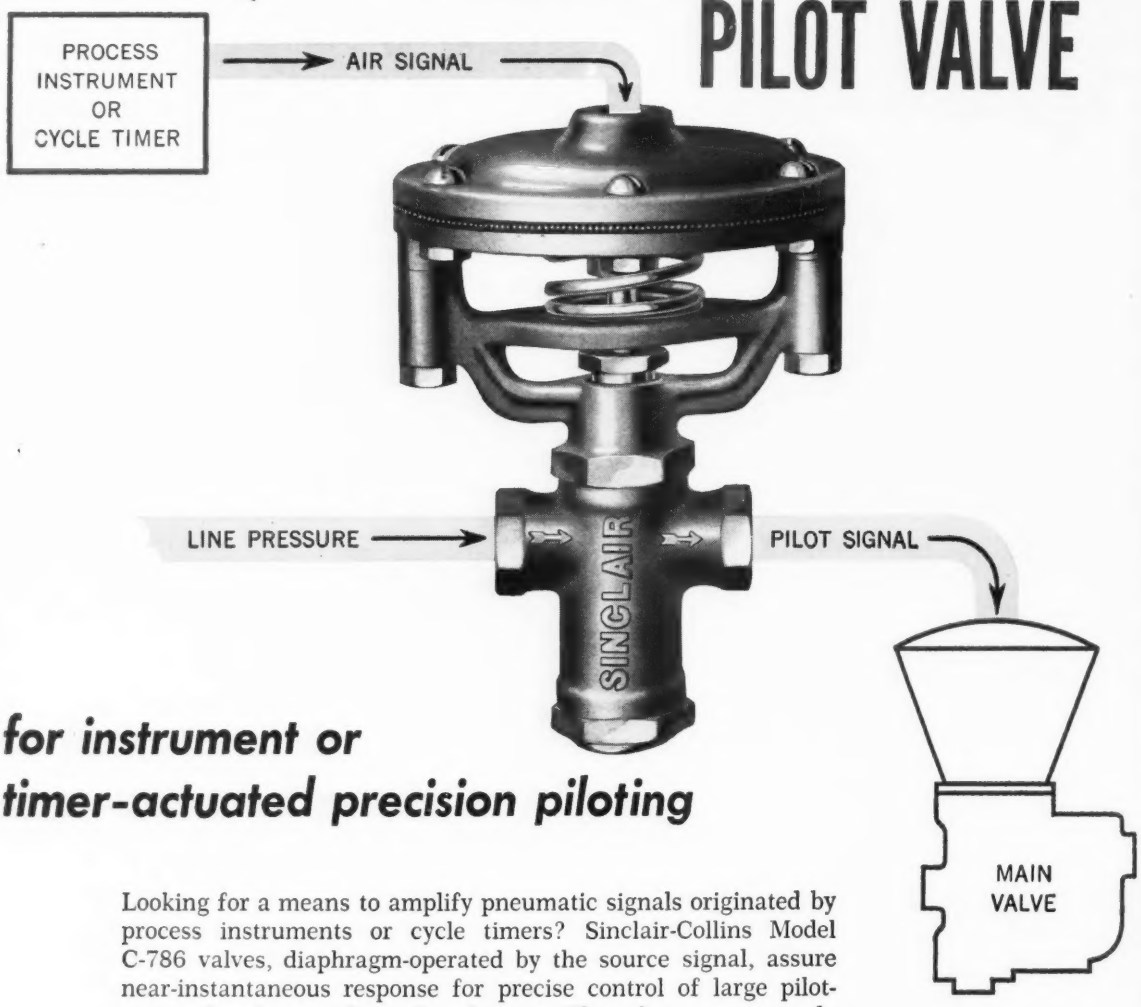
MOBAY CHEMICAL CO.

Code RW-1 **Pittsburgh 5, Pa.**

MOBAY

Pioneer in Urethane Chemistry

Compact, low-cost SINCLAIR-COLLINS PILOT VALVE



for instrument or timer-actuated precision piloting

Looking for a means to amplify pneumatic signals originated by process instruments or cycle timers? Sinclair-Collins Model C-786 valves, diaphragm-operated by the source signal, assure near-instantaneous response for precise control of large pilot-operated valves and similar devices. They feature extremely short stem travel, from closed to fully open, and a flow area equal to ¼ in. standard pipe.

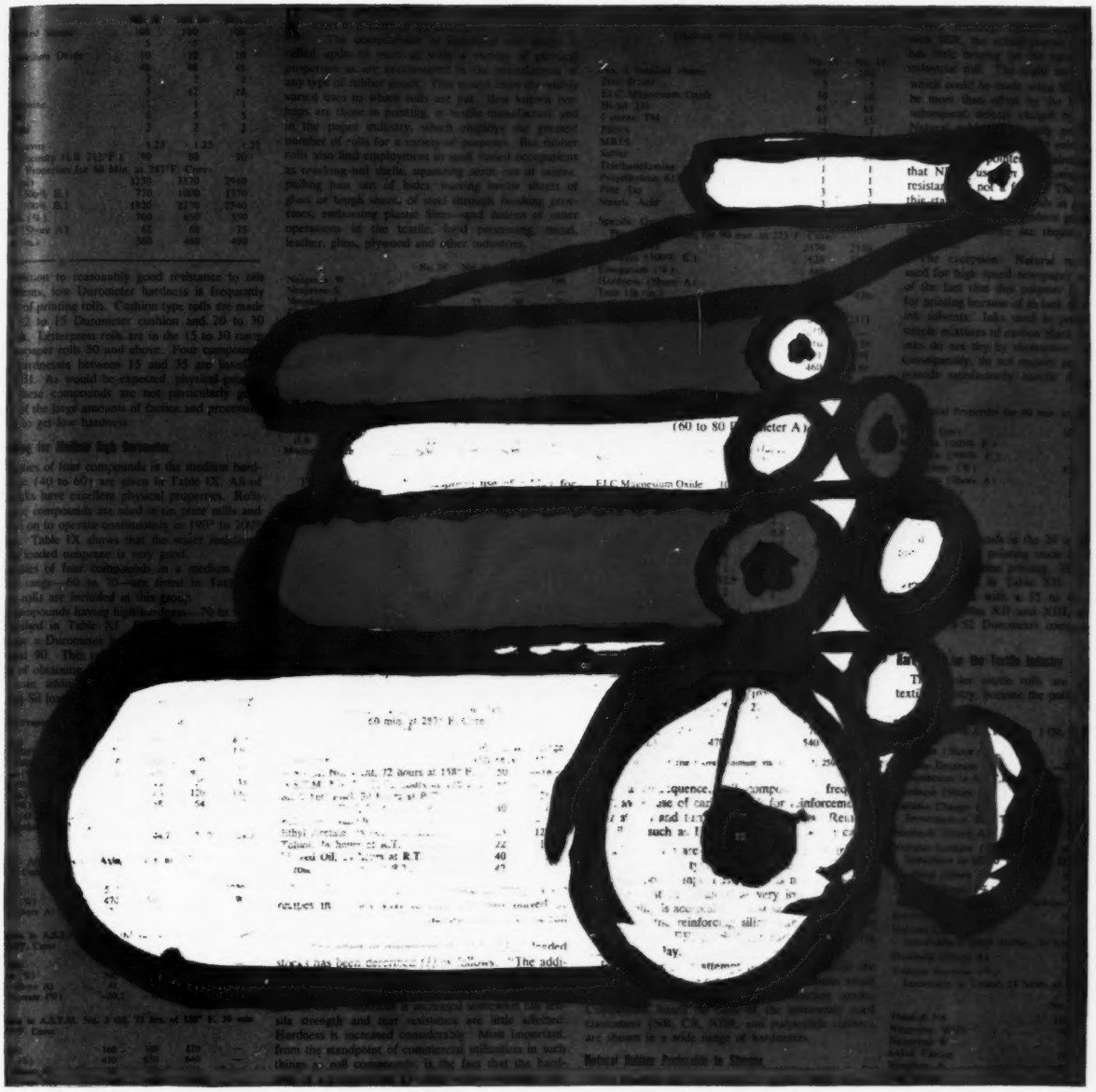
Space a problem? The Model C-786 measures but 5⅜ in. high . . . is only 3⅞ in. in diameter. Cost a problem? You'll find this valve, with all the built-in quality features found in every S-C valve, priced attractively.

Models for air, steam, hot or cold water, or inert gas service; bronze, ductile iron or stainless steel bodies; 2 or 3-way; 20 to 50 psi signal, 125 psi main valve; tapped ¼ in. NPT. Ask your nearby Sinclair-Collins Field Engineer to show you how the Model C-786 fits your instrumentation control system.

The SINCLAIR-COLLINS VALVE Co.
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)
AKRON 11, OHIO

For more information, write for Bulletin 59-SC. Address The Sinclair-Collins Valve Company, Akron 11, Ohio, Dept. RW-761.

8189



TOUGH OR TENDER . . . Compound light-colored rolls with versatile HI-SIL® 233 white reinforcing pigment

For clean handling of color-sensitive products like paper, textiles, plated metals and foods, nothing beats light-colored rubber rolls. Printers also like the ease of clean-up when changing colors on the press. Yet the wide range of physical properties required of various rollers makes compounding a real challenge.

Makers of rolls have found that HI-SIL 233 gives them the reinforcing qualities they need—even in soft goods with limited loadings—without marking problems. Hi-Sil 233 is the *white* reinforcing pigment for building long life into your light-colored rolls. Hi-Sil 233 has been proved out in compounds ranging from soft roll covers for crushing nuts and removing raisin seeds to tough, hard rolls exposed to sharp edges of metal sheets.

In addition to giving light-colored rolls superior physicals, Hi-Sil 233 gives the compounder a reinforcer that will disperse completely, increase building tack in compounds for medium and hard rolls, and contribute to easier handling.

Extensive data on compounding light-colored rubber rolls is covered in PPG Chemical Division's Hi-Sil Bulletin No. 23. Write for your copy to:

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BE CAREFUL ABOUT

TEMPERATURE

REJECTS ARE A TOTAL LOSS!

There is very little you can do with scorched rubber except charge it off to experience. Even with the rapid modern accelerators, scorching is avoidable. With the Cambridge Surface Pyrometer, the operator can check, thus control the surface temperature of mill, warming and calender rolls. It is an accurate, rugged, quick-acting instrument, so easy to use that operators are glad to use it.

Combination and single purpose instruments

Send for bulletin 194 SA

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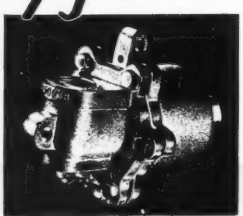
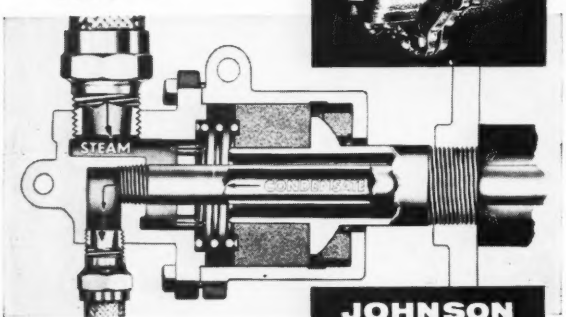
PYROMETERS

THEY HELP SAVE MONEY AND MAKE BETTER RUBBER

Need a rotary joint?

. . . for water-cooled or steam-heated rolls . . .





Type SB illustrated is completely self-supporting. For fully engineering data write for Bulletin S-3002.

JOHNSON Rotary Pressure JOINTS

Johnson started the whole idea . . . is far ahead in know-how, available types and sizes. Johnson Joints are completely packless, need no lubrication or adjustment. Used on dryer rolls, mills, waxers, calenders, slashers, printing presses, etc.—handling steam, water, hot heat transfer oils, Dowtherm, Mansanto Aroclors, etc. Actually serving under pressures as high as 2400 psi. Sizes up to 8".

THE JOHNSON CORPORATION

869 Wood St., Three Rivers, Michigan

new products

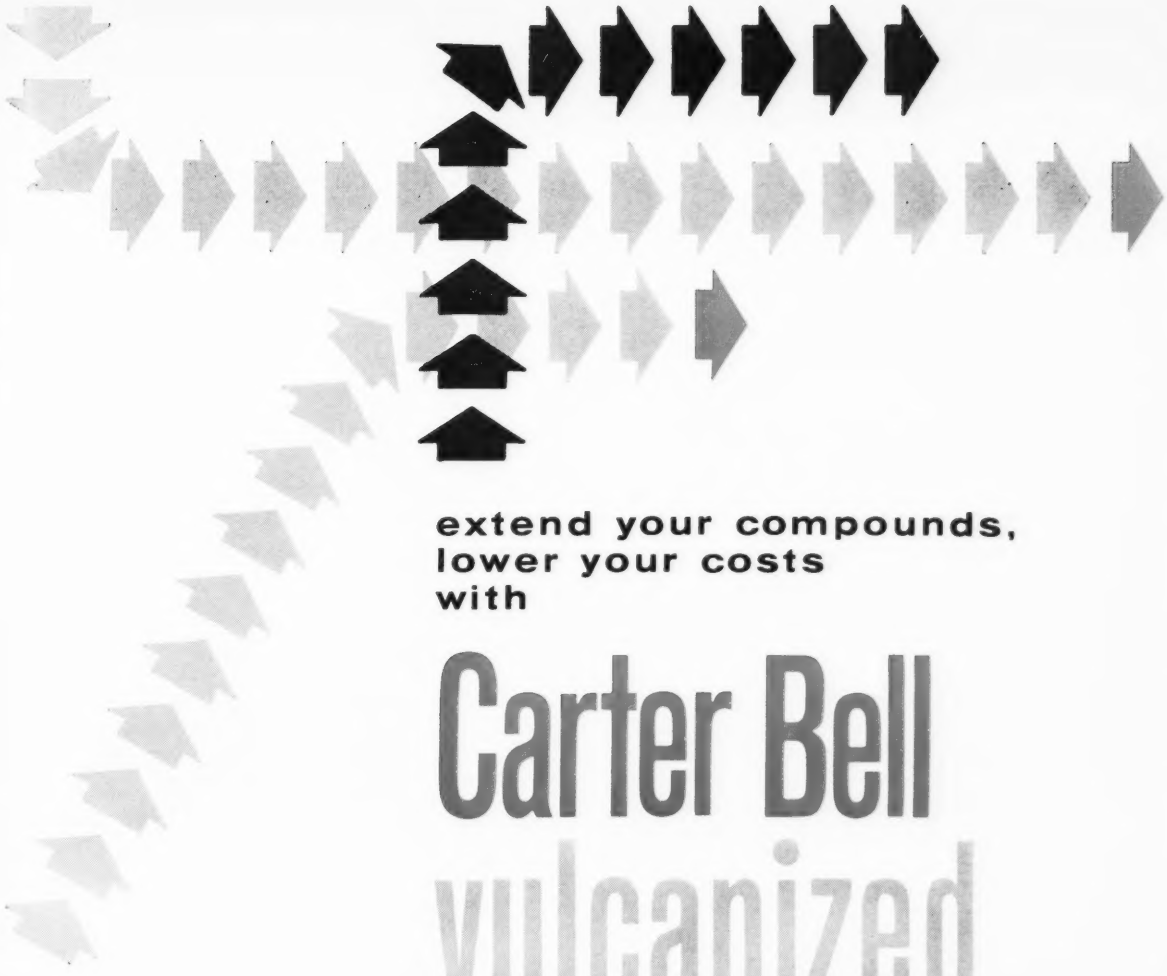
(Continued from page 34)

The Captive Air Safety Shield that fits within the regular tire is made of two partial plies of tempered steel and two plies of nylon. If for any reason the outer tire should fail, the motorist can continue driving at normal speeds for 100 miles or more, the manufacturer further claims.

Shown here are two of the rubber pods developed by The General Tire & Rubber Co., Akron, O., which contain the ingredients for concrete, ready to be mixed and used at any time. The reusable rubber containers each carry proper amounts of sand and gravel and water in one compartment and dry cement in a sealed inner bag. The company reports that use of the bag allows absolute control over the ingredients, insuring compliance with specifications and also the reduction in the number of transit mixers

New Adhesive Resists Aircraft Fuel Effects

A new adhesive formulated especially to resist the effects of splash and fumes of Type IV jet fuel and Type III aviation gasoline has been introduced by Schwartz Chemical Co., Inc., Long Island City, N. Y. Rez-N-Glue #249, an oil-resistant synthetic rubber-base of medium syrup viscosity, is recommended by the supplier for bonding light metal to plastic and vinyl and cured rubber-like materials to metal, woods, and ceramics. The solvent release-type, cold-setting adhesive is also said to be highly resistant to water, oils, heat, and cold.



extend your compounds,
lower your costs
with

Carter Bell vulcanized vegetable oils

MANUFACTURED BY
THE CARTER BELL MFG. CO.

IMPROVE mold definition and surface finish, flexibility and recovery. AID mixing, extrusion, dimensional stability and calendering. EXTEND high-cost, oil-resistant synthetic rubbers. INCREASE oil, ozone and light resistance. ACT as polymeric plasticizers and softeners.

Carter Bell Vulcanized Vegetable Oils (non-thermoplastic resilient solids) are available in ground or cake form; white, brown or black; soft, medium or hard to meet the requirements of any type of rubber compound.

Write for Complete Technical Data . . .

2581

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RECLAIMATOR® RUBBER...

... is a *world traveler*, too!

But *you* won't have to go around the world to discover the merits of the RECLAIMATOR.

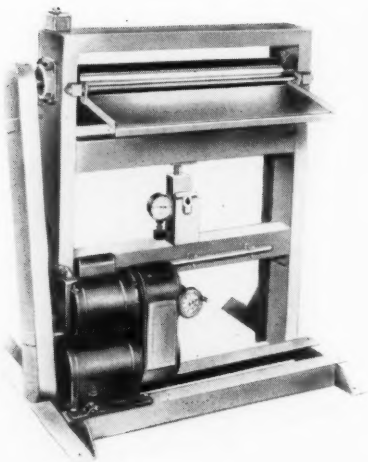
The RECLAIMATOR is an exclusive, patented system of reclaiming rubber which produces a superior product, faster and at a lower cost than conventional methods. Licensed plants, put into operation by our engineers and chemists, are currently operating in Europe, Asia and South America. Many more proposed installations are in the negotiation stage. Let us tell you how you can increase your profit and also help the economy of your country through a licensed installation of the RECLAIMATOR. Our more than 77 years experience in the field are at your disposal.

Write for 16 page folder.

Explains in great detail how RECLAIMATOR rubber can benefit you.

U.S. **RUBBER RECLAIMING CO., INC.**
BUFFALO, N. Y. VICKSBURG, MISS.

new equipment



Production perforating machine

Perforating Machine

A production perforating machine is being marketed by Robert A. Main & Sons, Inc., Wyckoff, N. J. The machine is made in roll widths of 33, 48, and 60 inches, with various needle-pointed pin patterns. Applications include rubber, rubber-coated fabrics, sheet film, leather, and thin metals.

New Press Brake

Pedersen Electronics, Lafayette, Calif., has developed a 30-ton press brake, actuated by a pair of electronically controlled hydraulic cylinders, which is reported by the company to be so sensitive that the operator can stop the ram within plus or minus five ten-thousandths of an inch. A ten-inch available stroke can quickly be set to match exactly each job, and it may be reduced in length to less than one inch. Full tonnage is available through the entire length of stroke, and the ram may be bottomed without danger of jamming.

This press does not have to complete a fixed cycle every time it starts downward; the ram can be inched up or down and stopped at any point, thus reducing the number of rejects due to improperly positioned parts, and also providing operator safety through the pedal-controlled ram, the manufacturer claims.

how to vastly increase the useful life of rubber...

Consider the effect of your curing system on the effectiveness of a chemical antiozonant

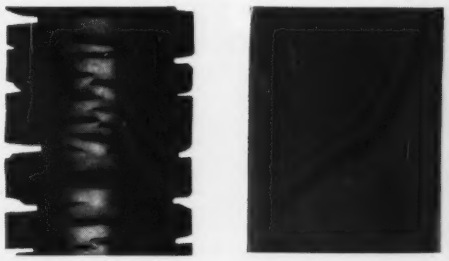
In compounding rubber, use of a potent antiozonant like UOP 88 or 288 is essential in assuring maximum crack-free life. But do you realize what a vast difference may be made by your *curing system?*

Look at the two rubber test strips illustrated. Both were formulated with UOP 88 . . . but note how much more effectively the antiozonant worked when accompanied by this change in curing systems —a vast increase in resistance to cracking!

Help in achieving maximum effectiveness from UOP 88 or 288 antiozonants is available through UOP facilities and technical personnel. Just write or telephone our Products Department.

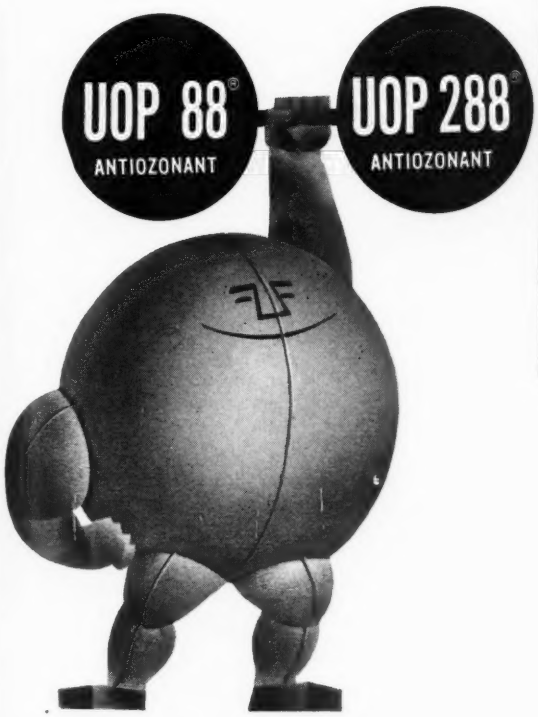
UOP ozone cabinets provide test conditions at a wide range of ozone concentrations.

The SBR specimens below were exposed to ozone at 100°F with 20 percent elongation for 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.



Carbon black—HAF (high abrasion furnace), Curing system—4 phr tetramethylthiuram disulfide; Hours to first crack—7 to 23.

Carbon black—HAF (high abrasion furnace), Curing system—2 phr sulfur, 1 phr N-cyclohexyl-2-benzothiazole sulfenamide. No cracks in 239 hr.



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Eagle-Picher offers you a comprehensive line of both lead and zinc compounds, produced with highest quality control standards to your exact specifications.

Our customer service and research staffs are geared to answer your special needs . . . with courteous dispatch and resourcefulness.

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Basic White Lead Silicate	Sublimed Litharge
Basic Carborate of White Lead	Red Lead (95%-97%-98%)
Sublimed White Lead	Sublimed Blue Lead

Lead Peroxide

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Since 1843

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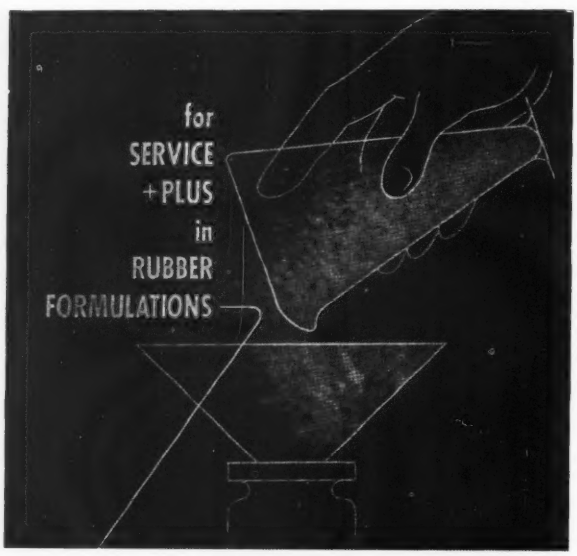


Use CLAREMONT *Cotton* FLOCKS

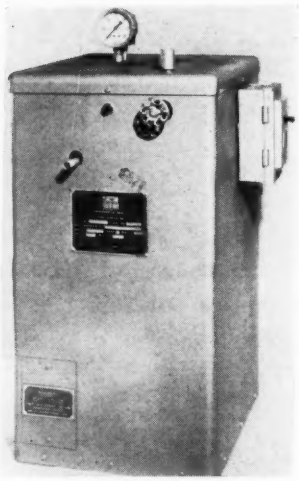
Claremont has served the rubber industry for over thirty years as a supplier of quality flocks produced to fit specific requirements. Whether used inside or outside, as a filler or as a finish, the superiority of Claremont Cotton Flocks is recognized by all users.

Used as a compounding agent in the manufacture of mechanical rubber goods and general sundries, Claremont Flock Fillers provide reinforcement, improve tear and abrasion resistance. Claremont flock finishes for rubber fabrics provide a wide range of appealing textures that are uniform and long-wearing. In many applications the proper use of a Claremont flock will substantially reduce production costs.

Claremont's knowledge of the industry's needs and its capacity for large production and quick delivery have made it the country's foremost producer of cotton flocks. Samples will be furnished upon request for laboratory and test runs. Inquiries invited!

CLAREMONT FLOCK CORPORATION
CLAREMONT, NEW HAMPSHIRE
The Country's Largest Manufacturer of Flock

new equipment

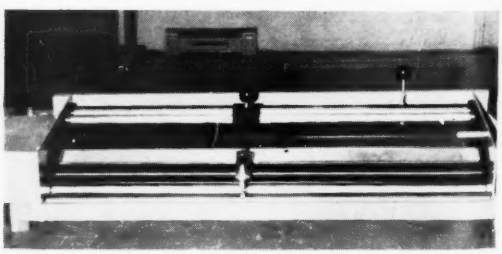


Speedylectric boiler

Electrode Steam Boiler

Pantex Mfg. Corp., Pawtucket, R. I., is now offering the Speedylectric Model RPL electrode steam boiler, which is useful where limited quantities of steam are needed. It is a simple plug-in unit with positive protection from low water or dry boiler damage.

The Model RPL provides low-pressure (0 to 15 psi.) steam for various industrial or laboratory uses. It will produce up to ⅓ Bhp. (3.3kw.) on 110-120 volts and up to ½ Bhp. (5 kw.) on 220-240 volts single-phase power. There are no pressure switches or relays with contacts to burn out or fuse closed, making the unit useful where dust or explosive fumes might be encountered or where unattended, uninterrupted service is essential.



Rubber thickness gage system

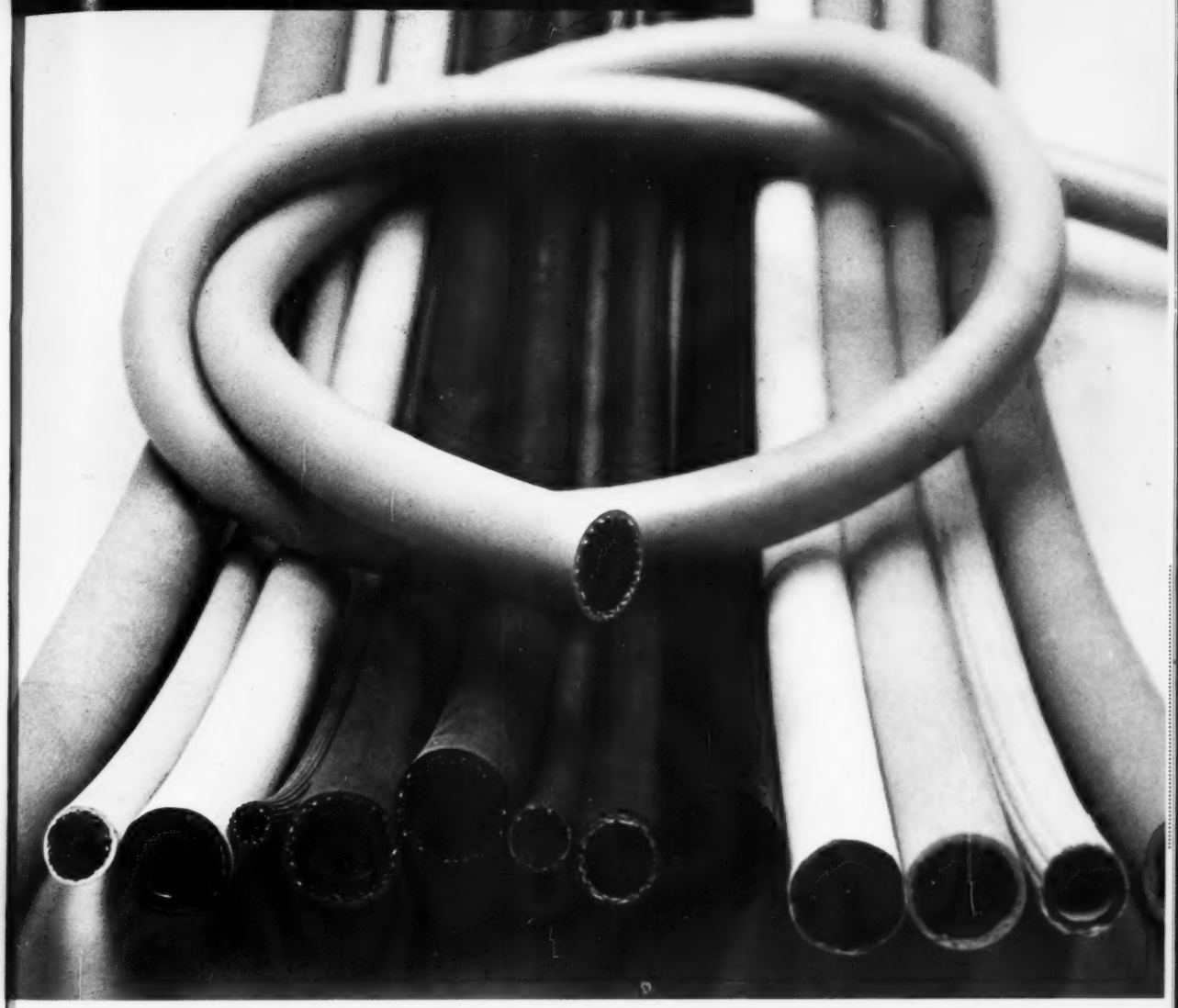
Rubber Thickness Gage

Industrial Components, Inc., Beaverton, Oreg., has developed a new rubber thickness gage system. In one installation it provides both a measurement of the tread thickness across the width of the extruded tread rubber and also a second movable

(Continued on page 60)

augatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



Great new advance in hose rubber

New PARACRIL OZO—exciting development from the laboratories of Naugatuck Chemical—offers the makers and users of rubber hose a combination of properties never before available.

Hose of every description, for practically every purpose, can be tougher, less bothered by abrasion, more oil and weather resistant than ever before. *And it can be produced in any permanent color desired!*

New PARACRIL OZO offers such advantages as:

- significantly superior ozone resistance
- excellent fuel and oil resistance
- several times greater abrasion resistance
- permanent retention of bright, uniform colors

Discover first hand the dramatic new sales possibilities this proven new rubber offers you. In increased product quality. In new production economy. For full information and whatever technical assistance you may require, contact your Naugatuck representative or write the address below today.

Naugatuck Chemical

Division of United States Rubber Company Dept. A Elm Street Naugatuck, Connecticut

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario CABLE: Rubexport, N.Y.

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CARTER BELL PRODUCTS
1903
SPRINGFIELD, NEW JERSEY

Vulcanized
vegetable
oils
rubber
substitutes

Types, grades and blends for every purpose, wherever Vulcanized Vegetable Oils can be used in production of Rubber Goods—be they Synthetic, Natural, or Reclaimed—including Adhesives.

A long established and proven product.

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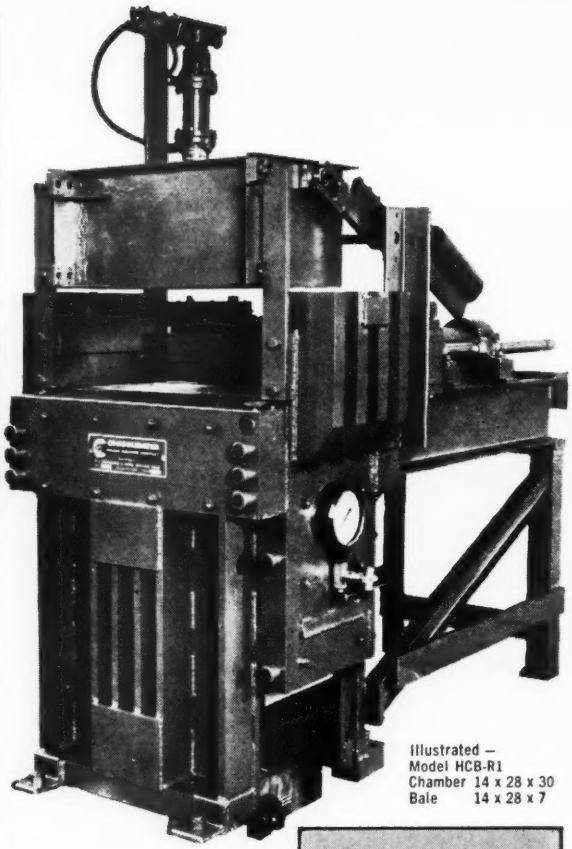
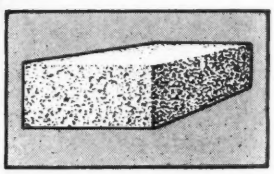


Illustrated —
Model HCB-R1
Chamber 14 x 28 x 30
Bale 14 x 28 x 7



AUTOMATIC BALER
FOR SYNTHETIC RUBBER

CLEANER
completely open top section permits use of telescoped loading chute to prevent spillage, keep floor and machine neater . . . eliminate costly cleanings.

FASTER
fully automatic high-speed cycles for loading, compression and ejection.

EASIER MAINTENANCE
sturdier all-steel welded construction adds durability and new simplified design keeps maintenance to a minimum.

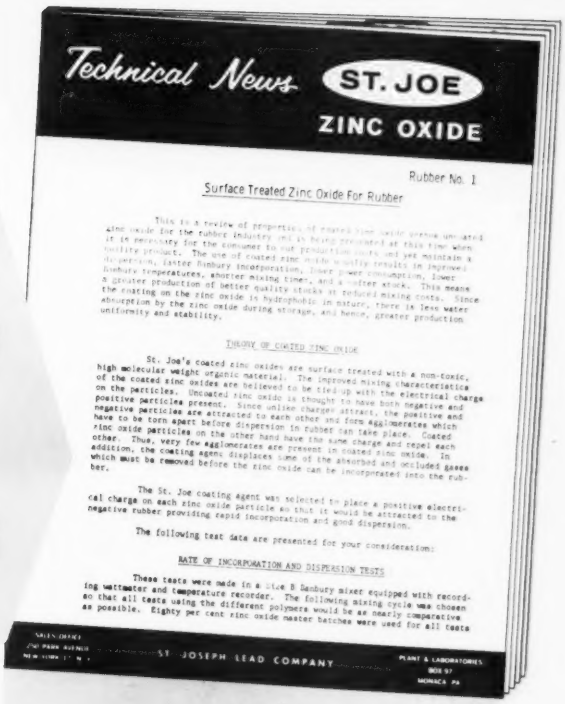
This new Consolidated rubber baler has been fully field tested and units are now being used in continuous operation at important rubber plants.

For details on their outstanding performance and full specifications please write.

CONSOLIDATED
BALING MACHINE COMPANY
3rd Avenue & 6th Street, Brooklyn 15, N. Y.
MAin 5-0928 (Area Code 212)

Another Example Of St. Joe's Technical Service To The Rubber Industry

Free Research Data On A ST. JOE Way To Reduce Your Processing Costs



Here, for the asking, are ten pages of test data which show precisely how St. Joe coated zinc oxide can improve quality and reduce your mixing costs.

Test showed St. Joe coated ZnO gives rapid dispersion, faster Banbury blending, less power consumption, shorter mixing time, softer stock and less water absorption. Report includes comparative test results on . . . . . .

INCORPORATION AND DISPERSION RATES

•

VISCOSITIES

•

ACTIVATION STUDIES ON VARIOUS STOCKS

•

HIGH VOLUME LOADING

(Stress/Strain, Tear, Blow-Out, Electrical, Water Absorption)

ZNO-194

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Plant & Laboratory:

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What's News in Rubber...

ENJAY BUTYL HT 10-66 gives this playground mat the ability to withstand years of scuffing and abrasion, repeated impacts and flexing, as well as outdoor weathering.

A NEW RUBBER TO DO THE HARD JOBS!

ENJAY BUTYL HT 10-66

Halogenated for...high heat resistance...covulcanization with other elastomers... low compression set... and faster cures

Plus these well-known Butyl advantages:

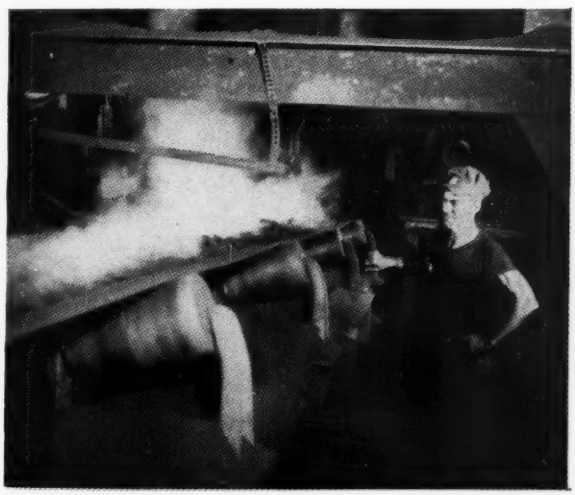
- *High flex, tear and abrasion resistance*
- *Low gas and moisture permeability*
- *Excellent chemical resistance*
- *High weather and ozone resistance*

NOW AVAILABLE IN A VARIETY OF MOLECULAR WEIGHTS

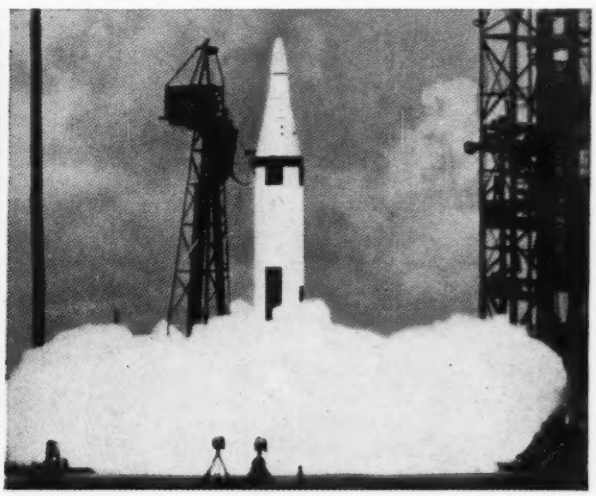
AIR-HOLDING INNERLINERS of Enjay Butyl HT 10-66 help assure correct inflation pressure for tubeless tires and can give greater blowout protection as well as improved tire-tread wear. Other tire uses include white sidewalls, black sidewall veneers and chafer strips.

APPLIANCE PARTS of Enjay Butyl HT 10-66 withstand the deteriorating effects of detergents and dishwashing compounds. Absorption of hot water by the rubber is reduced to a minimum.

HOT MATERIAL BELTS like this perform well at continuous temperatures of 350°F, thanks to the exceptional heat aging properties of Enjay Butyl HT 10-66.



SHOCK-RESISTANT LAUNCHING PADS of metal-covered Enjay Butyl HT 10-66 withstand launching shock and exposure to intense heat encountered in missile firings.



WRITE TODAY FOR NEW TECHNICAL MANUAL HT 10-66...

Contains processing information, performance data and recommended cure systems. For your free copy or for technical assistance in applying this important new polymer, write to Enjay, 15 West 51st St., New York 19, N. Y.

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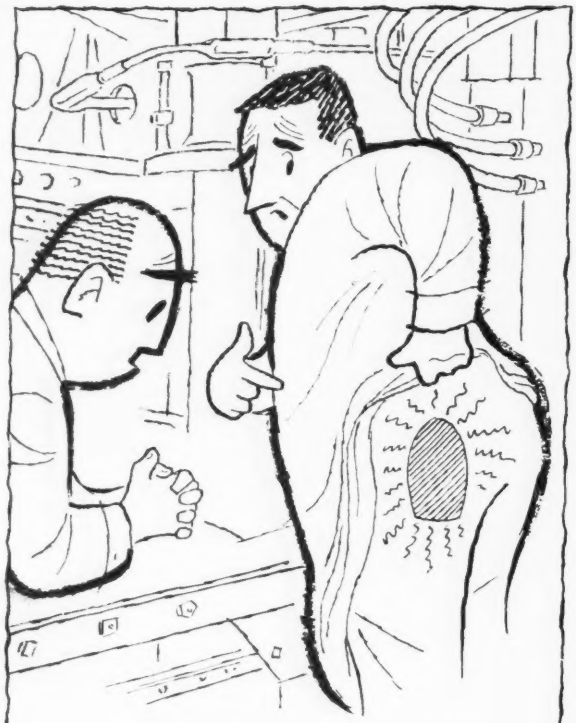
ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY® BUTYL



Now that we're using MAGLITE D for neoprene, scorch is no problem here—but what can I do about it at home?

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The performance-proved magnesium oxide

Why risk neoprene scorch when you can get the best protection at low cost with MAGLITE D? It is the most effective of all magnesium oxides, providing optimum protection during mixing and subsequent processing with practical cure rates. MAGLITE D usually allows higher mixing speed and provides better uncured stock life, safer tubing at higher die temperatures, faster tubing and wire covering, and better molding characteristics. Find out how MAGLITE D can help solve your neoprene problems. Send now for samples and information.

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AGENTS IN: Australia, Austria, Belgium, Canada, Finland, France, Germany, Hong Kong, India, Israel, Italy, Holland, Spain, Sweden, Switzerland, Union of South Africa, United Kingdom.

MAGLITE® Registered Trademark of Merck & Co., Inc.; Magnesia (Synthetic Calcined Magnesite).

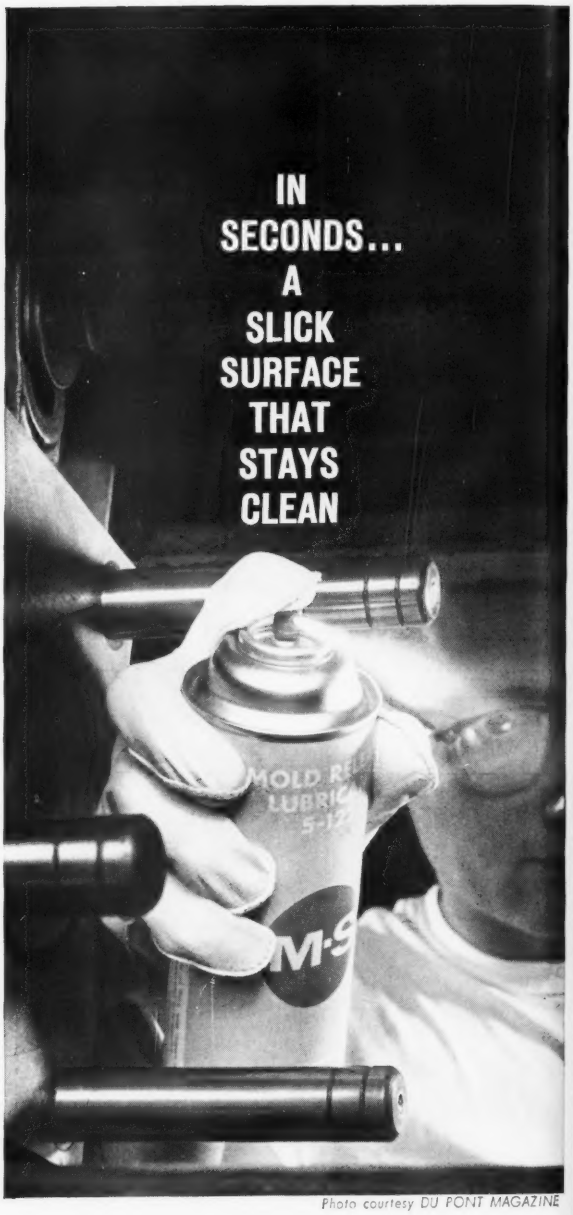

Photo courtesy DU PONT MAGAZINE

A new FLUOROCARBON Mold Release-Lubricant, S-122:

- Aerosol-packaged for easy application
- Dries instantly to a slick, clean coating that repels dirt, oil and water
- Won't run, stain or get gummy—even with prolonged use
- Withstands temperatures to 500°F.

For rubber – mold release and general lubricant.

For plastics – including tough-to-release epoxies and phenolics – and silicone rubber, versatile S-122 is the ideal mold release agent.

For electronic components, S-122 is widely used in potting and encapsulating applications.

Dry lubricant uses are endless.

16 oz. aerosol containers. $1.50 per unit in dozen lots, $2.50 per unit in less than dozen lots, F.O.B. our plant. Minimum order –$10.00.

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means clean, bright, new

is eye appeal

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Gone are the days of rejected merchandise because of yellowing on the shelves, fading and other "appearance failures." Glidden *Zopaque* Titanium Dioxide assures *certain* optical qualities: high opacity, hiding strength and tinting power.

Let Glidden *Zopaque* help you make your product (easily dispersible in rubber compounding) and sell your product through clean, bright, new, "BUY ME" eye appeal!

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QUALITY Glidden PRODUCTS

THE GLIDDEN COMPANY
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(This advertisement is printed on paper stock containing Glidden *Zopaque* Titanium Dioxide.)

"More than a quarter of a century experience"

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CAPITOL 4-S LINER PROCESS

The features are:

(1) Throws off moisture in the original fabric.

(2) Retards return of moisture. This is very important, particularly in the storage of compounds.

(3) Compound is water-insoluble, and gives the fabric a degree of water-repellancy: thus making liners suitable for many applications.

(4) The compound penetrates the fabric so-treated, thoroughly.

(5) Lasting release and fabric stability.

(6) Minimum shrinkage of fabrics during processing, and minimum width in shrinkage when in use.

(7) It can be applied to any fabric and paper as well.

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Extra Protection . . . Fast Cooling and Drying
Conserve Floor Space With . . .

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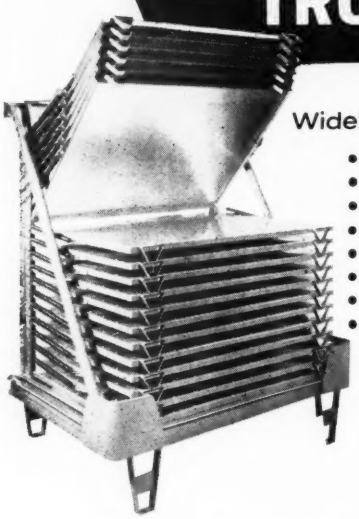
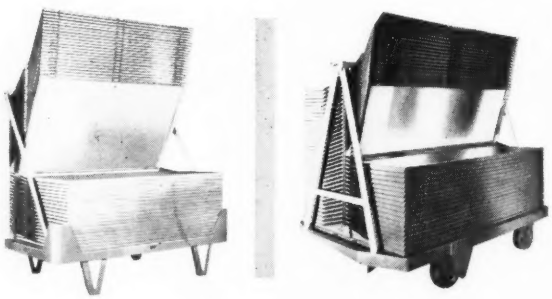


Widely used for . . .

- TIRE TREADS
- PLASTICS
- SOLINGS
- TILINGS
- ADHESIVES
- OVENS
- MILL BATCHES
- CALENDER STOCK

Spadone Trucks are built to withstand rough handling and assure years of maintenance-free service. Floating spring action raises and lowers trays at a touch. Heavy duty casters roll smoothly and easily and are positioned to provide maximum maneuverability.



All Spadone Trucks are custom built to order and designed to meet your individual requirements. Whatever the problem we will be happy to assist you, and all inquiries will have our prompt and careful attention.

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PITT-CONSOL

500 NS

PITT-CONSOL 500 NS RECLAIMER

PHYSICAL PROPERTIES

Physical State	Low viscosity liquid
Color	Pale amber
Specific Gravity (at 60°F)	1.072-1.080
Odor	Characteristic—practically none
Storage Stability	Excellent under normal conditions
Dispersibility	Excellent

...for non-staining quality in natural and synthetic rubber

PITT-CONSOL 500 NS is a highly potent chemical agent for reprocessing scrap or restoring partially cured compounds. It combines many efficient reclaiming advantages with an *unmatched ability to noticeably and definitely reduce staining and discoloration in natural and synthetic rubber.* Super-refined in nature, color and odor, it allows high retention of physical properties in compounds, is especially recommended wherever and whenever superior non-staining properties are required.

PITT-CONSOL 500 NS is also extremely active in reducing devulcanization time in the production of smooth, high quality staining or non-staining reclaims with low plasticity.

Write for sample and data. For new economies and efficiencies in your compounds, investigate all the reclaimers and peptizers in PITT-CONSOL's line of rubber chemicals.

PITT-CONSOL CHEMICALS

PITT-CONSOL Chemical Company

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HIGH QUALITY RUBBER CHEMICALS • PHENOLS • CRESOLS • CRESYLIC ACIDS • ARYL MERCAPTANS • ALKYLATED DERIVATIVES

technical books

BOOK REVIEWS

"1960 Supplement to Book of ASTM Standards, Including Tentatives." Parts 9 and 10. American Society for Testing Materials, 1916 Race St., Philadelphia, Pa. 9 by 6 inches. Heavy paper covers. $4 per part. (Complete set of supplements, is $40.)

The supplements are published annually between triennial publication of the Book of ASTM Standards. Part 9 covers plastics, rubber, electrical insulation, and carbon black, and Part 10 covers textiles, soap, water, atmospheric analysis, and wax polishes.

Those familiar with the Book of ASTM Standards know that it is a very valuable compilation of testing standards. For those unfamiliar with the publication, the 494-page Part 9 includes standards for rubber elastomers, latex, carbon black, sponge, hard rubber, coated fabrics, belting, hose, gaskets, automotive and aeronautical products, 68 standards for plastics, tests for mechanical, thermal, optical, and permanence properties of plastics, plus standards for rubber tapes, ceramics, mica, and other electrical insulating materials.

Part 10, which runs 334 pages, includes standards for fibers, yarns, threads, fabrics, asbestos textiles, cotton, wool and man-made fibers, in addition to soaps, atmospheric analysis, and wax polishes. This book is a must for the technical library.

"Die Analyse von Kautschuk und Kautschukartigen Polymeren." By G. W. C. Wake. Translated by F. Kirchhof. Published by Berliner Union G.m.b.H., Stuttgart. 1960. Cloth, 6¼ by 9 inches, 242 pages, 43 illustrations.

A German translation of Wake's "The Analysis of Rubber and Rubber-Like Polymers" had been contemplated soon after its appearance in 1958. Various circumstances delayed the project, and Wake took the occasion not only to amend the original work, but to add new sections dealing with developments that had taken place in the meantime, as well as to write a special preface to the German edition. Collaborating closely with the author, the translator has added data garnered in his many years of experience in investigating rubber and compounding ingredients in well-known laboratories and rubber factories. His contributions, mainly referring to problems in bitumens, factice, and reclaim, color reactions, and certain methods and apparatus of his own devising, have been worked into the text and also appear in occasional footnotes.

NEW PUBLICATIONS

"Paracril Ozo." Naugatuck Chemical, Division of United States Rubber Co., Naugatuck, Conn. 4 pages. This bulletin gives the advantages of Paracril Ozo, a blend of NBR and vinyl plastic which is used for shoe soles. The company reports that this material is practically impervious to oils, greases, various chemicals, and ozone attack.

"Compounding with Silastic (Silicone Rubber) Gums and Bases." 1961 Edition. Dow Corning Corp., Midland, Mich. 47 pages. This new edition brings up to date the valuable information of the last (1960) issue. There are some recent results on compounding materials and physical test data added to the fairly exhaustive information on types and ingredients of the previous issue.

"Recording Instruments." Catalog No. 625. Weksler Instruments Corp., Freeport, N. Y. This catalog covers the company's recording and controlling instruments for temperature, pressure, humidity, and time-of-operation.

"Super Tumblast." Wheelabrator Corp., Mishawaka, Ind. 28 pages. This catalog describes the complete line of the Wheelabrator Super Tumblast, batch-type airless abrasive-blast cleaning machines. Six sizes of this machine, ranging in operating load capacity from seven cubic feet to 100 cubic feet, are described.

Publications of General Electric Co., silicone products division, Waterford, N. Y.:

"Silicones for Electrical Insulation." Bulletin CDS-288. 8 pages.

"SE-5504—Self-Bonding Silicone Rubber Compound." Bulletin CDS-57. 4 pages.

"Hycar Latices for Adhesives." Latex Manual HL-1, April, 1961. B. F. Goodrich Chemical Co., Cleveland, O. 16 pages.

"Elastomers Notebook." No. 100. June, 1961. E. I. du Pont de Nemours & Co., Inc., elastomers chemical department, Wilmington 98, Del. 8 pages.

"Compounding Type 305 Shell Isoprene Rubber." Bulletin SC:61-84. Shell Chemical Co., synthetic rubber division, Torrance, Calif. 24 pages.

UNITED *Precision* ROLLS

for processing
RUBBER
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tile • linoleum
... and other
nonmetallic
materials

Precision . . . uniformity . . . dependability

Intangibles? Perhaps. You can't hold them in your hand. But you know if they're missing — especially when they're so vital in processing products you make.

Precision, uniformity and dependability are traditional at United. They are the ever-present intangibles you will find in United processing rolls. For more than 50 years, the design and manufacture of processing rolls has been a highly specialized, highly skilled practice at United. And this is just the beginning.

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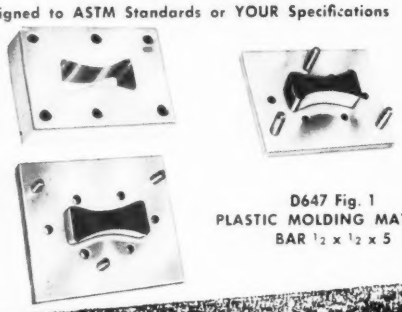
Progress... Leadership
United for Sixty Years

Plants at Pittsburgh, Vandergrift, Youngstown, Canton, Wilmington. SUBSIDIARIES: Adamson United Company, Akron, Ohio. Stedman Foundry and Machine Co., Inc., Aurora, Indiana.

Designers and Builders of Ferrous and Nonferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

When Ordering Steel Precision Molds
SPECIFY **HOGGSON**
Designed to ASTM Standards or YOUR Specifications

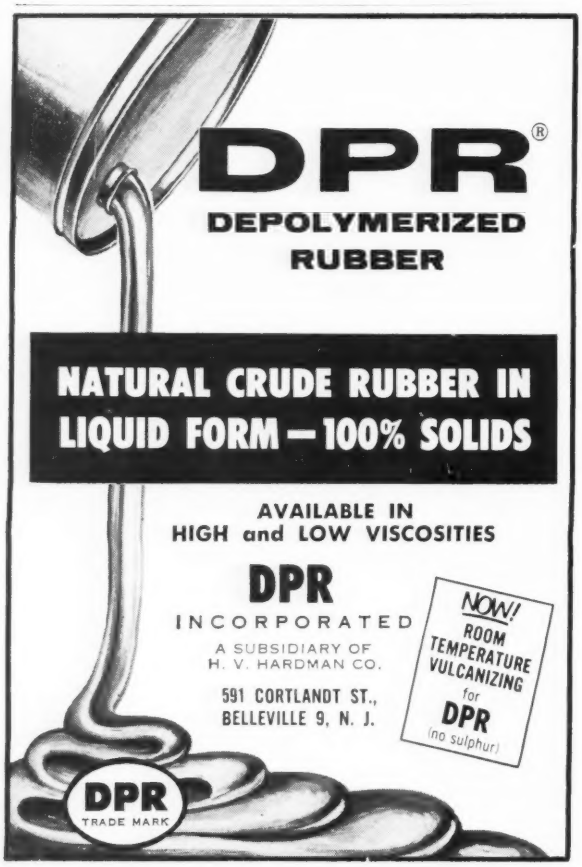


D647 Fig. 1
PLASTIC MOLDING MATERIAL
BAR ½ x ½ x 5

ANOTHER HOGGSON MOLD
Designed for a Specific Need

The D647, Fig. 1, Plastic Molding Material, Bar ½ x ½ x 5 was designed to answer a specific problem. Hoggson engineers are known throughout the world for reputable service in supplying manufacturers of rubber, plastic and synthetic products with precision molds and dies for test samples or actual production. Send your requirements for Hoggson's suggestions. Ask for literature.

HOGGSON & PETTIS MFG. CO.
1415 Brewery St., New Haven 7, Conn.
Pac. Coast: H. M. Royal, Inc., Downey, Calif.



technical books

"Chemfacts." No. 1. Hughson Chemical Co., Erie, Pa. 2 pages.

"Latex Accelerator Study—Thiurams and Dithiocarbamates in *Hevea* Latex." Pennsalt Chemicals Corp., industrial chemicals division, Philadelphia, Pa. 4 pages.

"Plioflex Packaging." Packaging PF-41. The Goodyear Tire & Rubber Co., chemical division, Akron, O. 2 pages.

"Techniques. Extending Carbon Black Masterbatches for Economical Mechanical Goods Compounds." Vol. 1, No. 6. United Carbon Co., Inc., New York 22, N. Y. 4 pages.

"Centrifugal Dust Separator." Bulletin E-221. The Day Co., Minneapolis, Minn. 12 pages.

"Conforming Matrix Electro-Formed Metal Spray Painting Masks." Form 7625. Conforming Matrix Corp., Toledo, O. 2 pages.

"Press Modernization." Bulletin ML-200. Fawick Corp., Fawick Airflex Division, Cleveland, O. 8 pages.

"B. F. Goodrich Industrial Gloves." No. 6500. B. F. Goodrich Industrial Products Co., Akron, O. 8 pages.

■

new equipment

(Continued from page 48)

gage roll which may be positioned laterally anywhere on the tread for measurement of taper or steps in the cross-section.

The thickness in either case is displayed on a seven-inch meter calibrated in 64-inch. The nominal range is zero to two inches; and accuracy is better than ±½% of full scale, it is also claimed. The display meter is separate from the gage itself and can be mounted in any location. Design features include built-in voltage regulator, linear scale, solid state components, and overtravel protection, resulting in good long-term stability.

Continuous Weigh Feeder

Thayer Scale Corp., Pembroke, Mass., is marketing a new continuous weigh feeder which automatically maintains a preset feed rate of ½-ton to 50 tons per hour. Designated the CM12 system, the weigher consists of a feeder, conveyor belt, and a flexure plate scale. The belt and its structural components, which are designed to prevent dust and material accumulation, are suspended from the scale. Several feeder types are available; the rotary feeder is for powdered materials that tend to aerate and flood, and the vibrating type, is for coarse and grainy materials.

see Pennsalt for rubber chemicals

ACCELERATORS AND VULCANIZING AGENTS

METHYL THIRAM, ETHYL THIRAM—Versatile primary accelerators, activators, vulcanizing agents for Hevea, SBR, nitrile, butyl rubber. Retarders for Neoprene GN.

METHYL ZIRAM, ETHYL ZIRAM, BUTYL ZIRAM—Active ultra accelerators and activators for Hevea, SBR and nitrile, especially for latex and wire compounds.

ETHYL SELERAM—Extremely active ultra accelerator for continuous vulcanization wire compounds and butyl rubber.

ETHYLAC®—Primary accelerator for Hevea, SBR and nitrile compounds. Provides good scorch time and rapid vulcanization. Excellent delayed action activator for thiazoles and sulfenamides, in both Hevea and SBR compounds.

DIPAC®—Sulfenamide-type primary accelerator for natural and SBR rubber. Exceptionally long delayed action followed by rapid vulcanization.

VULTAC®—Vulcanizing agents and resinous-type plasticizers for a variety of Hevea, SBR, nitrile and Hevea-SBR blend compounds.

ANTIOXIDANTS

PENNOX® **A**—Alkylated diphenylamine general purpose antioxidant for dry rubber and latex.

PENNOX® **B, C, D**—Nonstaining, non-discoloring hindered bisphenol antioxidants for Hevea and SBR vulcanizates and raw SBR polymer.

For compounding data and more detailed descriptions, write for a copy of our 40-page Rubber Chemicals Catalog, S-156.
Industrial Chemicals Division,
PENNSALT CHEMICALS CORPORATION,
3 Penn Center, Philadelphia 2, Pa.

See our complete listing in Chemical Materials Catalog

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H. M. ROYAL, INC., DOWNEY, CALIFORNIA

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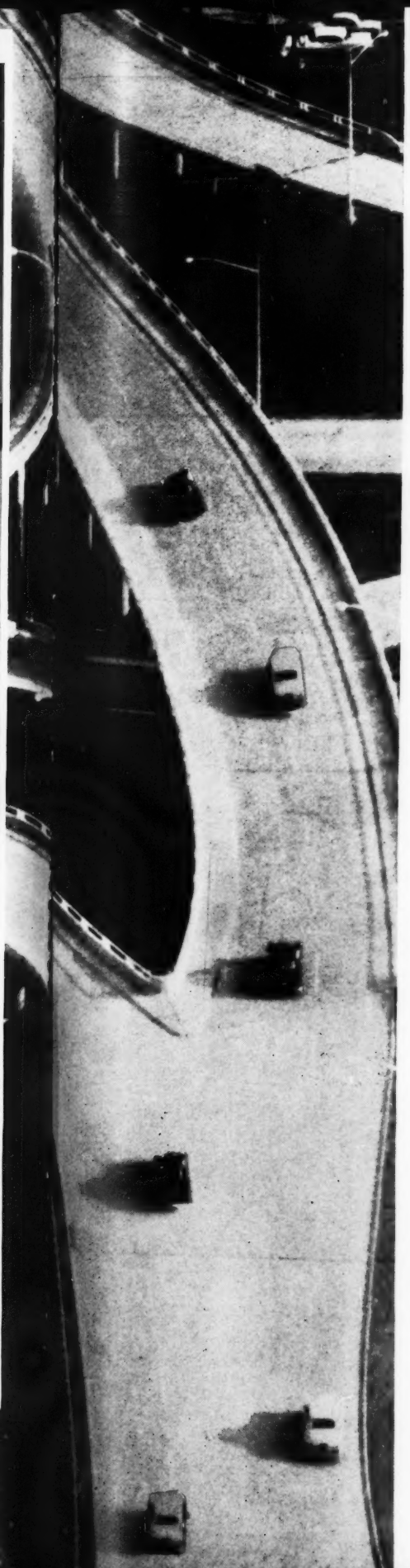
Pennsalt Chemicals
ESTABLISHED 1850

On our test fleet and under actual driving conditions Gentro-Jet proved its superior durability every time. Here gauges show 31% greater tread life in the tire made with Gentro-Jet 1609 SAF black masterbatch.



Gentro-Jet®

improves tread wear up to 30%!

Fleet road tests prove Gentro-Jet 1609 SAF black masterbatch offers better road wear in tires than any other commercially available rubber-black combination . . . more than 30% better wear than tires made with HAF black. Use Gentro-Jet in your formulations for improved tread wear.

GENTRO-JET BLACKMASTERS OFFER:
Faster processing • Savings in shipping, storage and handling • Assures cleaner in-plant operation.

Creating Progress Through Chemistry

Chemical Division
GENERAL
THE GENERAL TIRE & RUBBER CO.

THE GENERAL TIRE & RUBBER COMPANY
Chemical Division · Akron, Ohio

Chemicals for the rubber, paint, paper, textile, plastics and other industries: **GENTRO SBR** *rubber* • **GENTRO-JET** *black masterbatch* • **GEN-FLO** *styrene-butadiene latices* • **GEN-TAC** *vinyl pyridine latex* • **GENTHANE** *polyurethane elastomer* • **VYGEN PVC** *resins* • **KURE-BLEND** TMTD *masterbatch* • **KO-BLEND** *insoluble sulfur masterbatch*

HUBER

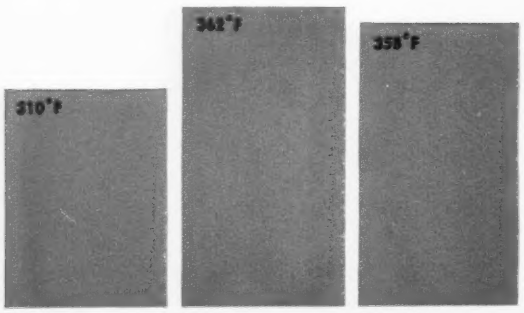
ZEOLEX 23

The unique, ultra-fine, white reinforcing pigment!

Generates less heat during mixing – gives excellent dispersion

Lower plasticity – smoother raw stocks!

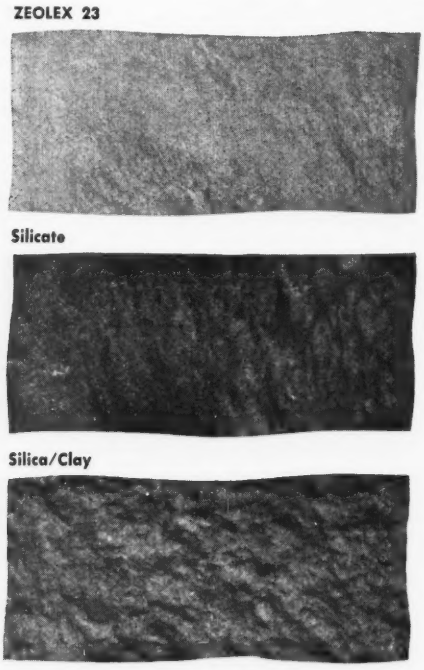
Heat generation during mixing



ZEOLEX 23 | Silicate | Silica/Clay

60 p.h.r.—SBR 1502

Stock smoothness



Mooney Viscosity

ZEOLEX 23	59
Silicate	62
Silica/Clay	81

MS—4′ @ 212°F.

For whiter, brighter products–use ZEOLEX® 23.

HUBER **J. M. HUBER CORPORATION** 630 Third Avenue, New York 17, N. Y.

Carbon Blacks • Clays • Rubber Chemicals

Our latest ZEOLEX 23 bulletin gives a lot of compounding information. Write for it.

Solid Urethane Elastomers— Valuable Engineering Materials

Rubber . . . plastic . . . both . . . or neither? Solid urethane elastomers, whatever their classification, offer the engineer some very desirable and intriguing properties. A combination of toughness, strength, and resistance to many environmental or service effects provides the designer in many fields with a new elastomeric material to meet his needs.

Mention urethane to most people, and they immediately start talking about foam. This is a major and growing use for this class of polymer, but we must not forget that we also have a rapidly expanding group of solid elastomers. A long hard look at these materials indicated that much was being done by the suppliers and fabricators of solid urethanes, but that little was being done to tell the story of the processes and uses of the various, and somewhat different, grades available.

In a departure, therefore, from our normal editorial policy of a diverse and balanced selection of articles, the RUBBER WORLD staff along with urethane experts has prepared a series of articles on this subject of solid urethanes to give you a current status report on these materials at one time and in one place.

Most present production of solid urethane parts is done with liquid systems requiring special equipment, with the molding being a casting operation. There are, however, grades also available which can be processed on conventional rubber machinery or on conventional plastic machinery.

Parts can be made from solid urethanes ranging from very soft and flexible to very hard, but still elastomeric. This wide range of hardnesses together with the other properties of urethanes permits the fabrication of parts which could not previously be made completely satisfactory from other rubbers, plastics, or even metals. Like other new materials before it, urethane rubber is not a cure-all for every problem. The proper use of the correct grade in a properly designed process and mold for a properly designed part, though, will result in adding to the serviceability of many products.

Incidentally, we refuse to answer our lead question. We leave the classification of urethanes to the nomenclature committees of the technical societies. We just want to tell the story.

R. S. Walker

EDITOR

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Urethane Rubbers Growing in Use

By STUART V. d'ADOLF
RUBBER WORLD, New York, N. Y.

ALMOST overlooked amidst the tremendous growth of urethane foams, the solid urethane rubbers appear ready for a great rise in use the next five years.

The urethane rubbers are never likely to be as big a seller as foams because of their high price—$1.40 a pound and up at present, compared with 90¢ for nylon on the one hand, and 30¢ for natural rubber on the other. Nevertheless, from a sale of some six million pounds last year, solid urethane rubbers are expected to increase sales to as much as 100 million pounds by 1965.

They are expected to cut into a number of markets now reserved for either plastics or conventional rubbers, basically because they can do some jobs that neither of the other materials can do.

In some cases they will move into the metals markets as well, particularly where not required to bear a load. This is true in many gear, bearing, and bushing applications, because the urethane rubbers combine very high abrasion resistance with resistance to solvents and oils, resilience, and vibration damping. In addition, their low coefficient of friction makes possible bearings which do not require lubrication, and their elasticity eliminates the need of the high tolerances required for metal parts.

Properties and Applications

Basically, the properties of the urethane rubbers are halfway in between those of conventional thermoplastics and conventional rubbers. Urethane rubbers can be made in a range of hardness from eraser softness (10 Shore A) to molded nylon hardness (75-80 Shore D), although most are now being made in the range from about 45-95 Shore A. Even in the very high hardness range, around 80 Shore D, these rubbers still have an elongation of about 250% and considerable resilience, which make them unique among materials.

Above 70 Shore A they also have higher tensile strength and modulus than conventional rubbers; good low-temperature flexibility; good heat aging from 180 to 250° F., depending on the type of urethane; excellent resistance to ozone and oxidation; excellent resistance to oils and most solvents, dilute acids, and alkalies, and good load-bearing capacity.

Two fields where they have already penetrated deeply are heel lifts for women's shoes, where a tiny lift must withstand a pressure of 15,000 psi. caused by the weight of a 120-pound woman, and the field of industrial wheels and pallet casters. In both cases, urethane rubbers are considered superior to both plastics and conventional rubbers, for both abrasion resistance and resistance to spread.

They are also being used for men's shoe heels and soles, for grease seals, oil seals, O-rings, airplane wing tanks, printing and coating rolls, paper and plastics rolls, rotors, pulleys, gears and gear shift linkages, flexible drive belts, conveyor belts, chute linings for highly abrasive materials, bottoming rings for shock-absorbing units, suspension bearings for heavy equipment, tubing for oils and solvents, wire and cable jacketing, elastic thread, and many other uses. Table 1 shows a comparison of some applications with the properties on which they are based.

Four Urethane Types

At present four types of urethanes are in the field: liquid castable urethanes, which are poured into molds and heat-cured after being mixed with a chemical curing agent; a thermoplastic resin for extrusion or molding; a semi-cured thermosetting urethane which can also be injection molded or extruded, then oven-cured to obtain final properties; and gum urethanes, compounded and cured like conventional rubbers and

TABLE 1. TYPICAL PROPERTIES VS. USES OF URETHANE RUBBERS

	Abrasion Resistance	Tensile Strength	Tear Resistance	Vibration Dampening	Bending to Metals	Load Bearing	Solvent Resistance	Low Coefficient of Friction—Special Stock
Bearings	x			x				x
Belts		x	x		x		x	
Bumpers				x		x		
Bushings								x
Casters	x			x		x		
Couplings				x				x
Drives	x			x				x
Gaskets						x	x	
Gears				x			x	x
Heel lifts	x					x		
Hose and tubing	x	x					x	
Mounts				x		x	x	
Packings	x					x	x	x
Pads						x		
Pedals	x				x			
Plungers	x						x	x
Pulleys	x				x			
Rolls, printing and coating					x		x	
Papermaking	x				x		x	
Rotors	x				x		x	
Seals	x				x		x	
Supports					x	x		
Tires, industrial	x		x		x	x	x	
Wheels	x			x	x			

processed on any conventional rubber equipment.

The castable urethanes are represented by E. I. du Pont de Nemour & Co.'s "Adiprene", Mobay Chemical Co.'s "Multrathane", and Goodyear Tire & Rubber Co.'s "Neothane," formerly called "Chemigum SL."

The only thermoplastic resin is the B. F. Goodrich Co.'s "Estane."

The semi-cured thermosetting rubber is Mobay's "Texin."

Finally, the gum urethanes are the General Tire & Rubber Co.'s "Genthane" and United States Rubber Co.'s "Vibrathane."

There is considerable dispute about the superiority of one type over another, but the castable urethanes appear to have the highest overall range of physical properties, including low compression set which compares quite favorably with that of conventional rubbers. The process of mixing a prepolymer with a curing agent for vulcanization, however, must be done with considerable exactness to achieve desired results, and mixing and pouring must be handled carefully to avoid trapping air bubbles in the mix. In addition, the casting and curing process, while advantageous for large or complex items which would be difficult to compression mold, and for special processes such as rotational or centrifugal casting, is somewhat slower than for other types of urethanes. For small items that must be turned out in great quantities, it may not be so well suited to low cost production.

Estane and Texin are both claimed to be considerably easier to process than the castable urethanes, not only because they can be used with high-speed molding machines and do not need long cure times (Estane is not postcured, and Texin can be used without a postcure, depending on the properties desired), but because the fabricator can use a standard solid compound, without worrying about mixing curing agents. In addition, scrap can be reused provided the product has not gone through a postcure. Goodrich claims that Estane scrap can be reground and reused almost indefinitely, and Mobay says Texin scrap has been recycled several times.

However, the properties of the two products, particularly modulus, compression set and abrasion resistance, appear to be somewhat lower than those of castable urethanes.

The two gum urethanes, Genthane and Vibrathane, appear to be halfway in between the castable urethanes, on the one hand, and the plastic-like Estane and Texin. Properties are not so high as for the castable urethanes, but can be improved in some respects by addition of reinforcing pigments. Genthane and Vibrathane can be processed on conventional rubber equipment and cured with a peroxide. Cure times are short enough to make a postcure unnecessary.

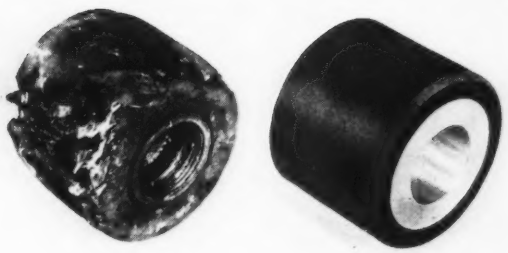
Two of the five products, Goodyear's Neothane and U. S. Rubber's Vibrathane, are being used at the moment only for products of the parent companies. The others are generally available.

Still another company, American Cyanamid Co., will be in the urethane field shortly. Cyanamid recently announced that a process for making a prepoly-

TABLE 2. COMPARISON OF TYPICAL PROPERTIES OF URETHANE, NATURAL RUBBER, SBR

	Urethane*		NR†	SBR†
Hardness, Shore A	65	92	70	70
Tensile, psi.	3,000	7,000	4,000	3,200
Modulus @ 300%, psi.	750	2,500	2,000	1,800
Elongation, %	430	450	550	450
Tear strength, lbs/in.	150	400	100	50
Oxidation resistance	Excellent	Excellent	Good	Good
Oil and solvent resistance	Good	Excellent	Poor	Poor
Metal adhesion, lbs/in	400	400	100	—

* Without reinforcement.
† Compounded with 50 parts EPC black.



mer is now in final development stages in its laboratories.

With this product, Cyanamid says, a processor can manufacture a product ranging in hardness from quite soft to very hard by using the same prepolymer and changing curatives. The company will offer five different curatives for use with the product.

Other products require both a specific prepolymer and a specific curative. This requirement is due to the chemistry of urethanes, in which a short-chain polyether or polyester is linked into a prepolymer of about 2,000 molecular weight by use of diisocyanates. This prepolymer is extended and simultaneously crosslinked by use of amine or glycol curing agents, or in some cases a peroxide. By changing the isocyanate and curing agent used, length of the polymer chain and crosslinking can be varied greatly, thus giving a great range of hardness, modulus, and other properties. Du Pont's polymer is based on a polyether; all the others on polyesters.

Curing agents and chemical intermediates, for use both in solid urethanes and foams, are sold by Du Pont, Carwin Chemical Co., American Cyanamid, Allied Chemical Corp., and several other companies.

One of the most important properties of urethane elastomers is high resistance to both cut and tear abrasion, and rolling and sliding abrasion, reported anywhere from two to ten times that of conventional rubbers in laboratory tests. This resistance depends on the type of urethane tested and on the temperature, since abrasion resistance of the material drops at higher temperatures.

Laboratory tests are seldom a completely reliable indication of abrasion resistance under service conditions. But, the companies have reported abrasion resistance high in industrial service. Four such examples of industrial applications, as reported by Du Pont, are indicative:

An Adiprene impeller used in a slurry pump at the acid leach plant of Faraday Uranium Mines, Ltd., near Bancroft, Ont., was only slightly worn after pumping 778,500 tons of slurry; while a natural rubber impeller was worn down to the metal after pumping 250,000 tons. The slurry contained about 25% of tiny rock particles, plus sulfuric acid used in the leaching process.

In another case, an Adiprene feed roll for handling plastic strands was only slightly worn after 225 days, when natural rubber feed rolls lasted only 28 days.

Adiprene was substituted for bearings, bushings, a spindle brake disk, a friction clutch, and other metal parts in automatic loom winders for glass fiber yarns. According to Leesona Corp., which developed the application for use on its looms, the urethane bearings lasted considerably longer than the metal parts they had replaced. In addition, they could be snapped in and out of place without the down time required to press out metal parts, didn't need the expensive parts because of their elasticity, and did not require lubrication.

At the Elizabeth St. Foundry Co., Chicago, Ill., 140,000 pounds of sand a month are blown through a duct leading from drying units. The average temperature of the sand is 175° F. At two places where the duct turned at right angles, ⅛-inch mild steel ducting wore through in a month. A special steel wore out in two months. Adiprene wear plates of ⅛-inch thickness fastened inside the duct lasted six months.

Urethane can be compounded to achieve either a low coefficient of friction for bearing application, or a high coefficient of friction where non-slip qualities are desirable. The low coefficient of friction, however, can be nullified in certain cases of rotating parts, since urethanes have comparatively high heat buildup. Effect of heat buildup can be minimized by using thin cross-sections which will dissipate heat. This is possible because of the high strength and load-bearing capacity of urethane rubbers.

Urethane rubbers of greater than 70 Shore A hardness have higher load-bearing capacity than conventional rubbers of the same hardness. For example, one type of urethane of 80 Shore A hardness requires a compression force of about 1,000 psi. to achieve 15% deflection. Natural rubber of the same hardness requires a compression force of only about 500 psi. to achieve the same deflection. At higher deflections the difference is not so great, but urethane still has the edge.

In the normal rubber range, conventional rubbers

are more resilient than urethanes. Above a hardness of 60 Shore A, however, resilience of natural rubber and other general-purpose elastomers drops off sharply; while the urethanes retain their resilience almost unchanged up to about 95 Shore A hardness. At 70 Shore A hardness, natural rubber is only half as resilient as urethane.

In addition, urethane is reported to have higher resilience than natural rubber within the temperature range of 50-250° F.

At normal hardness ranges for rubber, urethane has lower tensile strength and modulus, with somewhat higher elongation. At the higher ranges, up around 80 or 90 Shore A, urethane has significantly higher tensile and modulus and higher tear strength. It has

Fig. 2. Mallets with molded Adiprene heads can be used for such jobs as lining up refrigerator doors without chipping the paint or denting the metal. At the same time, the mallet head will last for several years without splitting, shredding, or mushrooming

fairly good low-temperature properties, with a brittle point as low as −80° F. for some types, and good heat aging up to between 180° F. to 250° F.; the lower figure is the top in very humid air.

Urethane is attacked by such powerful polar solvents as nitrobenzene or methylene chloride and by hot water or steam.

For a comparison of urethane properties with those of natural rubber and SBR, see Table 2.

One property which makes urethane useful for rolls, gears, and bearings is its elasticity. Besides making it possible to make parts with lower tolerances, and parts that may be snapped in and out easily, a urethane part will not be fractured by a small obstruction, unlike a more brittle plastic part.

Description of Products

Adiprene, Estane, and Texin are described in the

Fig. 3. Front suspension ball joint on 1961 Ford car uses Adiprene sliding seal for abrasion resistance, high tensile strength and low compression set, and superior resistance to weathering. The joints are sealed for a recommended 30,000-mile lubrication interval

articles that follow in this issue. The following is a brief description of the other urethanes, their properties and processing, as described by the manufacturers:

Fig. 4. This press-on wheel, manufactured by Disogrin Industries, Mount Vernon, N. Y., has a large number of lugs to prevent slipping on slippery inclines. The wheel, for use on materials handling trucks, withstands abrasion and cuts expensive down time experienced with conventional rubber wheels. In addition it is resistant to oils and chemicals found in plants

Castable Urethanes

Urethanes based on Mobay's Multrathane are available in hardness ranging from 60 to 100 durometer, Shore A. Tensile strengths range from 4,000 psi. for the softer grades, with elongation of 800%, to 8,000 psi. and 450% elongation for the harder types. Use of carbon black or other fillers is said to increase modulus, but decrease elongation. For a product of 78-83 Shore A hardness, tensile is 6,500 to 8,000 psi; elongation, 550-600%; 1,800 psi. at 300% modulus; and tear strength, 300-400 lbs in. For 88-92 durometer, tensile is 4,500 to 5,500 psi.; elongation, unchanged; 2,200 to 2,400 psi. at 300% modulus; and tear strength, unchanged. For 93-96 durometer, tensile is 4,000 to 5,000 psi.; elongation, 500%; 2,400 to 2,600 psi. at 300% modulus; and tear strength, 300 unchanged.

The material is processed by mixing polyesters, polyisocyanates, and curing agents in the liquid state at high temperatures, and pouring them into break-away aluminum or metal-filled plastic molds, then curing in a hot-air circulating oven. Curing times, however, are not given.

Goodyear's Neothane, like Multrathane, is mixed as a liquid and poured into molds. Neothane comes in a variety of hardnesses in two basic types, a "Standard" high-friction urethane, and a "lubricated" low-friction product. At 85 Shore A hardness, tensile for the standard grade is 6,500 psi.; elongation, 600%; and 2,250 psi. at 300% modulus. At the same hardness for the lubricated grade, tensile is 3,600 psi.; elongation, 500%; and 2,000 psi. at 300% modulus. Working temperatures of up to 200-225° F. in dry air, or 180° F. in moist air, are permissible, with occasional exposure to 300° F. for short periods.

Gum Urethanes

Genthane-S is available in gum stock with a Mooney viscosity of about 50 and can be processed on standard rubber equipment and cured with a dicumyl peroxide. Recommended cure time is 30 to 45 minutes at 300° F.

Properties of the gum vulcanizate include Shore A hardness of 54, tensile strength of 4,100 psi., elongation of 745%, 100 psi. at 300% modulus, and crescent tear of 100 pounds per inch. Compression set, Method B, is 17%. Loading of up to 50 parts of black will increase modulus up to 2,000 psi. Tensile can be increased up to 6,000 psi. by addition of up to 20 parts of black, but falls off rapidly with increased loading. Addition of high styrene resins up to 20 parts will increase Shore A hardness to 91 while raising compression set to 21%. Further loadings increase compression set sharply at only a slight increase in hardness.

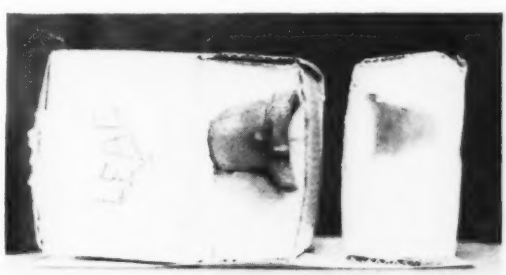
Vibrathane 5003 is a gum stock with a Mooney viscosity of 50, which can be processed on conventional equipment and cured with a peroxide. Recommended cure time is 30 to 60 minutes at 305° F.

Properties of the gum stock include Shore A hardness of 55, tensile strength of 3,400 psi, elongation of 500%, and 700 psi. at 300% modulus. Compression set, Method B, is 15%. Loadings of up to 30 parts of black will increase tensile to 4,170 psi. at 300% (modulus). Between 30 and 80 parts of black will increase hardness to 89 Shore A with a loss in tensile strength and sharp decrease in elongation.

Complete System for Urethane Form Packaging

The Leal Corp., Oaklyn, N. J., is now making available complete systems for the utilization of a revolutionary technique called PAK-N-FOAM which offers low unit packaging for products such as appliances, instruments, machinery, and other items needing protection from rough handling and abuse. Designated for use for in-place packaging systems utilizing urethane foams, the Leal process units include package design consultation, automatic metering and dispensing equipment for foams, tailor-made materials for packaging, and other services, as well as licenses under the patents held by the Freeman Chemical Corp. on this unusual packaging concept.

The Leal Corp. is prepared to install complete PAK-N-FOAM systems engineered to meet a customer's particular packaging requirements, provide appropriate materials to meet package and system requirements, train or provide personnel, and supply other materials and services required from a single responsible service. The system approach will provide users of the PAK-N-FOAM process with a complete operating packaging unit without costly development programs, and with predictable packaging costs for the packages made by the process.



This illustration shows a typical application of the Leal PAK-N-FOAM packaging system. One portion of the carton and foam has been cut away to show how this pipe joint section was completely encased in urethane foam within the paperboard carton

For further details on equipment, facilitation, and licensing arrangements write to the Leal Corp., P.O. Box 53, Oaklyn, N. J.

Estane Thermoplastic Polyurethanes

By C. A. WAUGAMAN and G. B. JENNINGS
The B. F. Goodrich Chemical Co. Development Center, Avon Lake, O.

INTEREST in elastomeric polyurethanes for extrusion, molding, calendering, and surface-coating applications has increased rapidly in the last five years. These polymers have high tensile strength, good tear strength, excellent ozone resistance, good solvent resistance, excellent abrasion resistance, and can be processed on conventional rubber equipment. The elastomeric polyurethanes heretofore available, however, require some kind of crosslinking or curing step to develop their useful properties.

In 1957, Schollenberger[1] described a new thermoplastic poly(ester-urethane) elastomer, Estane,[2] having a unique combination of physical properties and processing characteristics.

By careful selection of reactants and critical control of their interactions, Schollenberger was able to prepare an essentially linear polyurethane structure whose properties make it suitable for many applications without any need of a crosslinking or curing operation.

This paper describes the processing, properties, and applications of three varieties of Estane—low modulus 5740X2, medium modulus 5740X1, and high modulus 5740X7—now available to the plastics and rubber industries.

Processing of Estanes

A number of polyurethane elastomers such as Vulcollan,[3] Chemigum SL,[4] and the Adiprenes,[5] are available which have physical properties similar to those of the Estanes. All of these require either a hydroxyl-isocyanate crosslinking or a curing step. Standard rubber curatives can be used with Adiprene C, making possible the use of conventional rubber processing and curing equipment. The thermoplastic nature of Estane simplifies processing still further by eliminating the necessity of a crosslinking or curing step so that the standard thermoplastic processing methods of extrusion, injection molding, milling, calendering, solution techniques, and reprocessing methods may be used. The thermoplastic reprocessing characteristics of Estane have been demonstrated by regrinding injection molded scrap as many as eight times without any noticeable effect on molding or physical properties.

In general, processing conditions are similar to those used for poly(vinyl chloride) although there is some difference in milling operations. Estane's rheological properties are comparable with those shown by Ogden[6] for Adiprene C. Below optimum processing temperatures Estane has considerable nerve, but shows only slightly more nerve than natural rubber at milling temperatures of 325-350° F. Although Estane exhibits thixotropic behavior on a mill and forms a progressively smoother sheet under shear, it never forms so smooth a sheet as poly(vinyl chloride) unless its temperature is raised to the point where it is likely to stick to the mill rolls. Since Estane will readily accept pigments and lubricants even when the sheet is much rougher than poly(vinyl chloride), pigments should be added as soon as a continuous band is formed, even though the sheet is still fairly rough.

If the stock temperature is inadvertently raised to the point where sticking occurs, it should be reduced as quickly as possible, but only for ease of milling since there is no danger of polymer crosslinking or degradation. Opening the mill to reduce frictional heat build-up is usually a faster method than reducing roll temperatures. In an extreme case of sticking, the rolls can be stopped, and the stock removed until it drops to 325 °F. before putting it back on the mill.

Milling can be greatly simplified by the use of the proper lubricants. Lubricants can prevent sticking by reducing the processing temperatures and thus widening the temperature range between the satisfactory processing temperature and the sticking point, and also by reducing frictional heat build-up. An adequate lubrication system is already present in most of the compounds supplied, but not in any of the raw polymers. Lubrication is recommended for all molding, extrusion, and calendering compounds. This is the most effective means of obtaining mold release and will increase extrusion and calendering rates by as much as 30%.

Selection of the right lubricant is very important. Waxes are effective as mold release agents, but in general are so incompatible and difficult to mill into Estane that their use is not recommended except in applications where a surface exudation of wax might be desirable. Most metallic stearates mill in quickly and easily without even breaking the band. Barium stearate is one of the best general-purpose lubricants and can be completely dispersed within 3-4 minutes after the batch is banded. Barium stearate is normally used at about 1% concentration, but has excellent compatibility and shows no sign of exudation at levels as high as 4%.

Estane, as supplied in ¼-inch cubes of compound or straight polymer, usually contains an equilibrium moisture content of approximately 0.6% at 50% relative humidity,[7] but owing to the completely reacted nature of the polyurethane this water cannot form any

[1] C. S. Schollenberger, H. Scott, G. R. Moore, RUBBER WORLD, Jan., 1958, p. 549.
[2] A registered trade mark of B. F. Goodrich Chemical Co., Cleveland O.
[3] Farbenfabriken Bayer, Leverkusen, Germany.
[4] Goodyear Tire & Rubber Co., Akron, O.
[5] E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
[6] RUBBER WORLD, July, 1957, p. 537.
[7] K. Dinbergs, Goodrich Research Center, unpublished work.

hydroxyl-isocyanate linkages and does not affect the properties of the polymer in any way. The moisture can be reduced by a drying operation similar to that used at times in processing polyamides. An equally effective method of avoiding the porosity which can result from excessive stock temperatures is to maintain carefully the recommended processing temperatures.

Extrusion and Molding

In molding or extruding the standard Estane compounds, the stock temperature range for compounds based on 5740X1 is 330-350° F., and 10-15° F. higher for compounds based on 5740X7. Table 1 shows the extrusion conditions most suitable for extruding Estane 58013 Black, a jacketing compound based on 5740X1.

TABLE 1. ESTANE EXTRUSION CONDITIONS

Compound	Estane 58013 Black (Based on 5740X1)
Stock temperature, °F.	340–350
Extruder temperatures, °F.	
Cylinder rear	200
Front	300
Head	325
Die	350
Screw	Neutral
Screw design	Most vinyl or polyethylene types
Screw speeds, rpm.	10–60

Table 2 illustrates typical injection and compression molding conditions for 5740X1 and 5740X7.

These stock temperatures may not always be the best for processing compounds which have had certain lubricants added in the field for processing or mold release. Lubricants can affect both moisture retention and flow temperature of Estane. For example, 5740X1, which is compression molded at 350° F. with barium stearate lubrication, will become porous because of the release and vaporization of moisture when compression molded with lead stearate lubrication at the same temperature. By dropping the molding temperature to 325° F., however, the lead stearate compound can be molded easily without porosity. The reduction in molding temperature of this compound would indicate that the flow properties can be changed greatly by the addition of lubricants. This point has been confirmed by a melt index study which showed that the rate of extrusion at a given temperature can be doubled by the addition of 1% of lubricant.

The solubility characteristic and unlimited pot life of Estane solutions make possible a completely new

TABLE 2. ESTANE MOLDING CONDITIONS

Estane Polymer	5740X1*	5740X7*
Injection molding		
Stock temperature, °F.	350	360–375
Barrel temperatures, °F.		
Rear	250	270
Front	350	360
Nozzle temperature, °F.	350	360
Ram pressure, psi.	20,000	20,000
Cycle time, seconds	30–90	30–90
Mold temperature, °F.	100	100
Shrinkage, in./in.	0.009	0.008
Compression molding		
Stock temperature, °F.	350	360
Mold temperature, °F.		
Initial	350	360
Final	100	100
Cycle time, minutes		
Preheat	5	5
Mold hot	5	5
Cold, under pressure	5	5
Pressure on stock, psi.	500–1500	500–1500

*Lubricated with 1 phr. of barium stearate.

Madison Geddes

G. B. Jennings

Rudy Moc Studio

C. A. Waugaman

The Authors

Charles A. Waugaman, development group leader in the products application laboratory of B. F. Goodrich Chemical Co. Development Center, has been with Goodrich since 1952. Before his present assignment in urethane development, he had assignments in development of SBR, NBR, and vinyl products. He received his B.S. in chemical engineering from Northeastern University in 1947 and was employed as a process engineer by General Foods Corp. from 1947 to 1950 and a field representative for the synthetic rubber division of Reconstruction Finance Corp. in 1950 and 1951.

Garland B. Jennings, development supervisor for new products development at the Goodrich Development Center, holds six patents in rigid vinyl plastics. He received his B.S. and M.S. in chemistry from Vanderbilt University and was an instructor at Vanderbilt from 1935 to 1940. Next he was employed as a chemist by Wilson & Co. He has been with Goodrich since 1945.

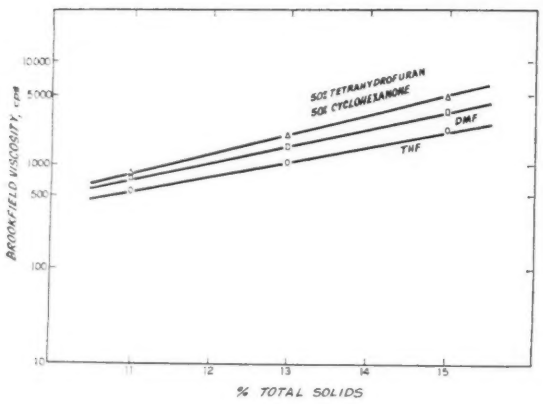


Fig. 1. Polyurethane coatings may be applied by dissolving Estane in certain solvents. Curves show solubility of Estane 5740X1 in 50% tetrahydrofuran and 50% cyclohexanone, as well as in dimethyl formamide and in tetrahydrofuran

method of applying polyurethane coatings. The conventional methods rely either on an isocyanate-polyester two-package system which must be kept separate until the coating composition is to be applied, or on blocking the isocyanate reaction by formation of a complex which remains inactive at room temperature until it is decomposed by an elevated-temperature baking cycle which reactivates the isocyanate.

Estane Coatings

Estane 5740X1 and 5740X7 are not highly soluble polymers although certain strongly solvating solvents will dissolve them. Estane 5740X1 is soluble in tetrahydrofuran, dioxane, cyclohexanone, and dimethyl formamide. Figure 1 shows its solubility characteristics in some of these solvents. Estane 5740X7 is soluble only in dimethyl formamide.

Estane 5740X2, the modulus type, was developed for applications where greater solubility and the use of less expensive solvents such as methyl ethyl ketone are desirable. Its solubility curves in tetrahydrofuran and methyl ethyl ketone are shown in Figure 2.

TABLE 3. PHYSICAL PROPERTIES OF ESTANE

Property	Estane 5740X1	Estane 5740X2	Estane 5740X7
Specific gravity	1.20	1.20	1.20
Shore hardness			
"A" scale	88	70	96
"D" scale	35	23	49
Stress-strain properties*			
Tensile strength, psi.	5840	5000	5840
300% Modulus, psi.	1240	420	2800
Ultimate elongation %	540	720	490
Graves angle tear, lbs./in.†	430	250	700

*ASTM D 412. American Society for Testing Materials, Philadelphia, Pa.
‡ASTM D 625.

TABLE 4. ABRASION RESISTANCE OF ESTANE

Test Method	Estane 5740X1	Estane 5740X2	Estane 5740X7
Goodrich Pico Index			
% of natural rubber standard	360	125	110
Taber abrasion, gm. loss			
CS-17 wheels 1000 gm./wheel, 5000 rev.	0.0025	0.1515	0.0023
ASTM D 394-47, NBS Method			
% of natural rubber standard	180	—	225

Some of the most obvious solution applications are in cements, migration barriers, impact and abrasion resistant lacquers, and topcoats. The Goodrich Research Center has studied the weather resistance of Estane and provided a valuable background for the development of coatings subject to outdoor weathering.[8] As with many useful polymers such as the polyamides, polyethylene, and the vinyls, crosslinked unprotected polyurethanes undergo some degradation on exposure to natural and artificial weathering conditions. Weathering of unprotected Estane causes a decrease in ultimate tensile strength, although the surface remains flexible, and there is no significant change in modulus and ultimate elongation.

The best protection against weathering for Estane has been attained by the addition of carbon black, which has proved to be an almost perfect barrier to the ultraviolet initiated autoxidation weathering process which is sensitized by radiant solar energy. Slightly less effective, but still satisfactory, are certain titanium dioxides and UV absorbers which make possible light-colored exterior Estane coatings.

Properties of Estane

The physical properties resulting from the thermo-

[8]S. C. Schollenberger, K. Dinbergs, "A Study of the Weathering of an Elastomeric Polyurethane." Washington, D. C. SPE RETEC, Dec., 1959.

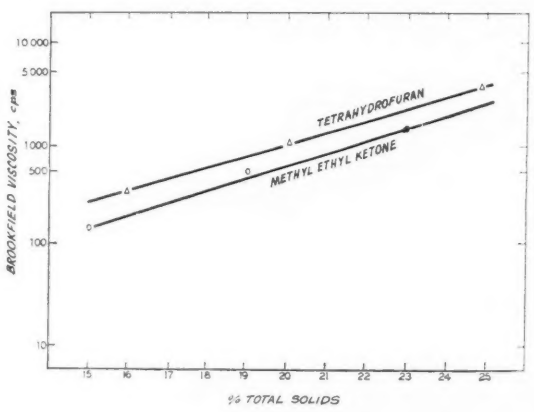


Fig. 2. Curves show solubility of Estane 5740X2 in tetrahydrofuran and methyl ethyl ketone

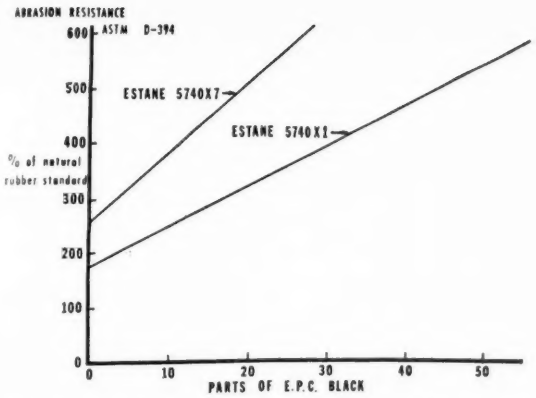


Fig. 3. Abrasion resistance of Estane can be increased by addition of carbon black. The effect of addition of from 10 to 50 parts of EPC black is shown here

plastic processing of Estane are shown in Table 3. These properties are equivalent to those of the typical crosslinked or cured polyurethane of similar hardness.

One of the most valuable attributes of all polyurethanes is their resistance to abrasion and wear. This property is frequently much more outstanding under actual service conditions than is indicated by standard test methods, but even these tests in Table 4 illustrate the excellent abrasion resistance of the Estanes.

This abrasion resistance can be increased severalfold by the addition of 10-50 parts of EPC black, as shown in Figure 3.

The low-temperature flexibility of Estane is more like that of vulcanized rubbers than its thermoplastic nature would suggest. Figure 4 compares the low-temperature flexibility of Estane 5740X1, natural rubber, and nitrile rubber, by the German torsional method.[9]

The low-temperature flexibility of the Estane falls between natural and nitrile rubber. Gehman freeze points and low-temperature Izod impact of the Estanes are shown in Table 5.

Polyurethanes are resistant to a wide variety of salt solutions, dilute acids and bases, and petroleum based fuels, oils, and greases. The chemical resistance of Estane 5740X1 to some of these materials is shown in Table 6.

TABLE 5. LOW-TEMPERATURE PROPERTIES

Estane	5740X1	5740X2	5740X7
Gehman low-temperature freeze point, °C.*	−31	−27	−17
Izod Impact, ft. lbs./in. of notch at			
73° F. (23° C.)	No break	No break	No break
−17° F. (−27° C.)	2.2	—	—
−60° F. (−51° C.)	0.67	—	—

*ASTM D 1053.

TABLE 6. CHEMICAL RESISTANCE OF ESTANE 5740X1; 28 DAYS' IMMERSION AT 23° C.

	Weight Change, %	Tensile, psi.	Elongation, %
Original	—	5500	530
20% NaOH	−1.98	3300	580
20% H_2SO_4	+0.60	3800	590
Saturated NaCl	+0.76	3870	550
Distilled H_2O	+1.05	3760	590
Type I Fuel A	+0.58	4460	570
II Fuel B	+9.50	2900	620

Urethanes swell and degrade in hot water, concentrated acids and bases, polar solvents, high concentrations of aromatics, and strong oxidizing agents. Since the chemical resistance of Estane is still under investigation, its performance should be tested under the actual service conditions expected.

Since Estane is thermoplastic, its compression set is greater than that of the crosslinked polyurethanes, but its resiliency is slightly better. In actual service conditions Estane has been satisfactory at temperatures as high as 200° F. The compression set values of Estane can be improved by a dicumyl peroxide cure, but this curing operation eliminates Estane's primary processing advantage—its thermoplasticity.

Polyurethanes have excellent oxygen and ozone resistance. An Estane 5740X1 compound showed no change in properties when stretched 20% for two weeks at 120° F. in a 25 pphm. concentration of ozone.[10]

Although one of the largest volume applications for Estane is in the wire and cable industry, its electrical properties are inadequate for primary insulation, as

(*Continued on page 84*)

[9]S. D. Gehman, D. E. Woodford, C. S. Wilkinson, *Ind. Eng. Chem.*, 39, 1108 (1947).

[10]C. E. Fleming, B. F. Goodrich Chemical Co., unpublished work.

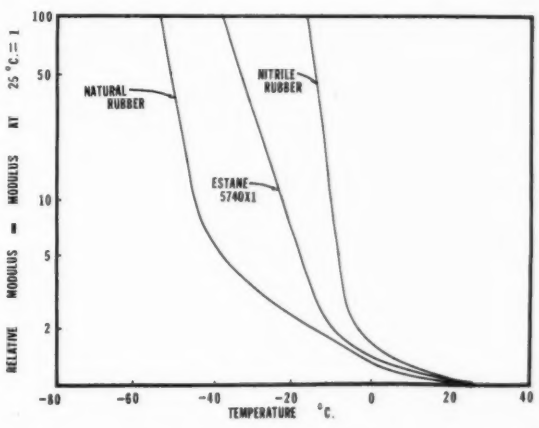


Fig. 4. Effect of temperature on torsional modulus of Estane is compared with similar curves for natural rubber and nitrile rubber

Texin Solid Urethane Elastomers

By R. S. WALKER
RUBBER WORLD, New York, N. Y.

A URETHANE elastomer supplied in a chopped particle "green stock" resin form which can be easily handled in extrusion and injection or transfer molding is one of the newest developments in this rapidly expanding polymer field.

These fully compounded, partially cured solid urethane elastomers have been introduced by Mobay Chemical Co. under the trade name "Texin." At the moment two grades are furnished commercially: Texin 280 A and Texin 192 A. The 280 A, specifically designed for extrusion, cures to a final hardness of 80 (Shore A durometer); while the 192 A, suitable for injection molding, cures to a hardness of 92 (Shore A durometer). (See Table 1.) In addition, polymers with hardness ranging from 60 (Shore A) to 65 (Shore D) have been prepared as experimental products, some of which may be obtained in limited quantities.

Now mass production of elastomeric parts difficult to obtain defect-free in volume by casting can be accomplished by well-known thermoplastic processes such as injection molding. These free-flowing, one-part resins are particularly suited for parts with design features such as undercuts, slots, tapers, gear teeth, threads, and integral inserts, but will probably not replace the liquid (castable) systems in certain large-size parts such as industrial truck tires.

The use of fast-cycle, low-cost existing equipment along with the ability to recycle material from sprues and runners should help to reduce substantially the cost of parts made from these relatively high priced elastomers. Spanning the gap between flexible rubbers and rigid plastics, the urethanes provide the design engineer with a material with properties which can eliminate some of the deficiencies of previous polymers or even metals.

Parts or components may be made having the hardness of non-elastic materials while retaining the resiliency, elasticity, impact resistance, and recovery characteristics of rubber-like materials. Property values may be specified ranging from a highly flexible, rubbery material to a solid of such hardness, toughness, and mechanical strength that parts made of it have outworn machined steel components by as much as 30 times.

Outstanding Properties of Texin

Some of the outstanding properties are:

- Wide range of hardnesses.
- Tensile strengths ranging from 4,000 to 8,000 psi., with elongations from 450 to 800%. Softer grades have lower tensile modulus values than harder types.
- Tear strengths (measured by Federal Specifications FTMS-601 and M-4221) ranging from 250 to 350 pounds per inch for the softer grades and approaching 400 pounds per inch for harder grades. Note that the tear strength increases with hardness.
- High-temperature functional range, 180° F. in air and 230° F. in oil. Low-temperature brittle point ranging from −42 to −70° C., depending upon the Texin grade under test.
  Solvent resistance generally superior to all synthetic rubbers and most thermoplastics.
- Excellent ozone and oxygen resistance. Some discoloration may occur, but physical properties are unaffected.
- Dielectric constant ranging between 6.7 and 7.6 at 800 cycles, with a loss factor of 0.016 to 0.017. The volume resistivity is in the range of 10^{10} to 10^{11} ohm-centimeters. Surface resistance may be reduced to 10^{9} by 24-hour immersion in water.
- Low abrasion loss, low noise level, and high coefficient of friction properties.
- Good oil resistance. Most oils and fuels have little effect on elastomer properties, although some types of oil additives may attack the material.
- High normal coefficient of friction which may be controlled or reduced by use of additives to impart self-lubricating qualities which also improve the already high abrasion resistance.

While little investigative work has been done, there are good indications that other processing methods such as compression molding, milling, calendering, and solution coating may be employed with some Texin compounds.

TABLE 1. TYPICAL PHYSICAL PROPERTIES OF TEXIN URETHANES

Property	280 A	192 A
Specific gravity	1.25	1.25
Bulk factor	2.7	2.7
Hardness, Shore A durometer	80	92–94
D durometer	—	44–45
Tensile, psi.	5500	4400
Elongation, %	600	600
Modulus, 100% psi.	650	1150
200%, psi.	900	1550
300%, psi.	1500	2050
Elongation set, %	30	45
Tear strength, lbs.*	—	300

* Tear strength by Federal Specifications FTMS-601, M-4221.

TABLE 2. TYPICAL PHYSICAL PROPERTIES OF TEXIN 280 A EXTRUDATES

Monofilament Diameter, In.	Cure* Method	Tensile, psi.	Elongation, %	Set, %	Modulus, psi. 100%	200%	300%
0.074	A	4,900	600	78	810	1,150	1,700
0.040	B	17,000	265	0	1,800	8,200	—
0.017	C	27,000	210	0	12,800	25,500	—

*A: Extruded as a monofilament and cured 72 hours at 110° C. (230° F.).
B: Cured as in A, but then stretched 400-500% at 25° C. (770° F.) for one minute, released, and tested one week later.
C: Stretched 400-500% and then cured while in the stretched state for 72 hours at 110° C. (230° F.).

Extrusions

The extrusion grade (Texin 280A) has been successfully handled on laboratory and production-size machines. Some data have been presented which show that molecular orientation is possible following extrusion of this material. A certain amount of orientation can be obtained by air cooling the extrudate and then drawing. A greater degree of orientation may be obtained by heat curing the extrudate while it is held under tension. Typical properties are shown in Table 2.

Most of the extrusion work during development was done on a ¾-inch machine having an L/D ratio of 20:1; a single-flight, constant-pitch variable depth screw without torpedo; a compression ratio of 3:1 and 4:1; and equipped with electric heating.

The Texin pellets were fed directly into the feed throat at room temperature. Both the rear (feed) section and the front section of the cylinder were maintained at temperatures of 325 to 350° F. The ⅛-inch-diameter round die, contrasting with normal thermoplastic materials, was maintained at a lower 280 to 325° F. The use of these temperature gradients provides more back pressure and in turn more shear.

A 1½-inch extruder operated at essentially the same conditions except that temperatures were slightly lower. The cylinder sections ran at 310 to 330° F., and the die heated to 280 to 295° F. No particular problems were noted.

The only warning note is that any equipment used should be clean. Any contamination by residual amounts of other materials can result in poor extrusions or moldings.

Injection Molding

Injection molding of samples for physical tests were made on a small bench-mounted injection press.[1] The cylinder temperature was set at 325 to 375° F., and the pressures ranged from 1700 to 9850 psi. Mold shrinkage was found to be approximately 0.0092-inch per inch. The mold should be kept at room temperature to facilitate release. At mold temperatures of 100 to 140° F. some sticking was noted. An aerosol silicone release agent minimized this sticking.

Each mold and each injection press will require different operating conditions to produce satisfactory parts, as might be expected. The ram pressure and cycle should be varied within the 325 to 375° F. temperature range.

Table 3 may be used as a guide in varying molding conditions within a given cycle to produce acceptable parts.

Specimens for physical testing were postcured for 16 to 24 hours at 230° F. The effect of postcuring has not been fully investigated. There are some indications that high-temperature post-cure will reduce compression set, and that room temperature postcure for a week will increase tensile strength and modulus and reduce compression set. Further work is under way to confirm these results.

Transfer Molding

A limited amount of preliminary work indicates that transfer molding can be accomplished using temperatures of 350 to 375° F. with pressures of 300 to 500 psi. Poor surface appearance is an indication that the temperature should be increased.

In some cases involving very complex molds it may be necessary to cool the mold to 200° F. before removing parts to avoid splitting or sticking.

The mold cycle for transfer molding will range from five to 30 minutes, depending upon the complexity of the mold and the force needed to remove the parts from the mold.

A modified method for transfer molding, as suggested by Mobay researchers, is as follows:

The mold, instead of being heated, is maintained at near ambient temperatures. In order to accomplish this satisfactorily, it is necessary to have the transfer pot somewhat elongated and the transfer ram shortened so that it does not bottom in the pot. The transfer pot is heated and used to preheat the ground stock so that it

(Continued on page 84)

TABLE 3. PROCESS CONDITIONS FOR INJECTION MOLDING TEXIN 192 A

Cylinder Temp., °F.	Pressure, psi.	Hold Time, Sec.	Cycle, Min.
325	1000–1200	20	1.0
350	600–800	20	1.0
375	200–400	20	1.0

[1] Minijector "Super Wasp," Newbury Industries, Inc., Newbury, O.

Liquid "Adiprene" Urethane Rubbers

By M. L. NADLER

Elastomer Chemicals Department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

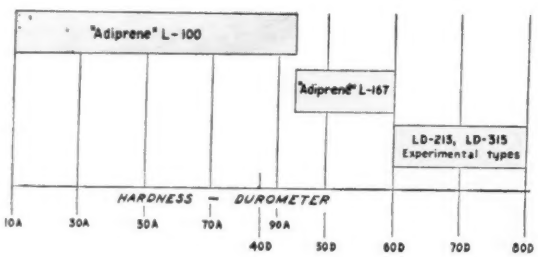


Fig. 1. Four "Adiprene" products span the range of hardness from 10 Shore A to 80 Shore D

THE term liquid "Adiprene" urethane rubber refers to a family of urethane elastomers which are cured by chemical reaction. The physical characteristics of cured products of "Adiprene" can be controlled over an unusually wide useful range by selecting the appropriate "Adiprene" and the optimum curing agent and processing conditions. The skillful chemist and compounder utilize this new dimension in product control to design end-product systems with outstanding performance. This status report summarizes the properties of "Adiprene," processing variables, fabrication techniques, and product applications.

Chemistry and Properties

The liquid "Adiprene" materials are essentially isocyanate-terminated reaction products of polyfunctional isocyanates and a four-carbon-based polyether glycol. The latter contributes importantly to the excellent physical properties of the cured products. Among these properties are high modulus and load-bearing capacity, toughness, and resistance to abrasion, oxygen, ozone, oils, many chemicals, and radiation. Among the urethanes the low-temperature properties of "Adiprene" are outstanding.

Each of the four types of liquid "Adiprene" urethane rubber now available is designed to yield optimum cured properties over a fairly specific hardness range. This is shown in Figure 1, where the optimum hardness ranges are given for "Adiprene" L-100, "Adiprene" L-167, and two newer experimental materials, LD-213 and LD-315.

The most widely used curing agent for "Adiprene" is the hindered diamine 4,4′ methylene-bis-(2 chloroaniline) usually referred to as MOCA. MOCA provides an unusual balance of pot life, cure rate, handling ease, and vulcanizate properties. For certain applications, however, polyols, other polyamines, and even atmospheric moisture are used.

Table 1 summarizes the broad spectrum of properties which can be obtained with the various liquid "Adiprene" polymers. Some of the more important variables which control these properties are discussed in the next section.

The hard cured products of liquid "Adiprene" are of special interest. As shown in Figure 2, they offer much higher load-bearing capacity than conventional elastomers. Figures 3A and 3B illustrate that they retain the elongation associated with elastomers.

The polymers LD-213 and LD-315, designed to yield very hard vulcanizates, are still under development. Their cured products offer an unusual combination of the hardness generally associated with plastics plus the resilience and resistance to deformation of elastomers. New design concepts are possible with such materials.

The Author

Martin L. Nadler, at present assigned to market development in elastomer chemicals for the elastomer chemicals department of E. I. du Pont de Nemours Co., Inc., Wilmington, Del., has held positions in research, manufacturing and sales with Du Pont's organic chemicals and elastomer chemicals departments since 1941. A registered professional engineer, he received his B.S. in chemical engineering in 1940 and his M.S. in 1941, both from the Columbia School of Engineering. Holder of several patents in the field of rubber chemicals and organic chemical intermediates, Nadler is a member of the American Chemical Society and the national program committee of the American Institute of Chemical Engineers.

TABLE 1. PROPERTIES OF PRODUCTS OF CURED "ADIPRENE"

A. Medium to Hard Range

Compound Designation	A	C	B	D	E	F	G	H	I
Physical Properties									
Durometer hardness	55A	65A	75A	85A	92A	50D	58D	70D	75D
100% Modulus, psi.	200	300	700	700	1100	1800	2400	3600	3500
Tensile strength, psi.	2500	3000	4500	4500	5000	8800	8500	6000	7500
Elongation at break, %	650	430	430	440	450	420	330	200	250
Specific gravity	1.06	1.10	1.10	1.10	1.10	1.135	1.16	1.185	1.20
Thermal conductivity, BTU/(hr.)(sq.ft.)(°F./in.)	1.181	1.040	1.010	0.952	0.917	0.862	0.927	0.854	0.754
Linear coefficient of thermal expansion, in./in./°F.									
−32° F. to +32° F.	1.22×10^{-4}	1.40×10^{-4}	1.35×10^{-4}	1.27×10^{-4}	1.43×10^{-4}	1.27×10^{-4}	1.08×10^{-4}	0.80×10^{-4}	0.79×10^{-4}
32° F. to 75° F.	0.77×10^{-4}	1.00×10^{-4}	1.05×10^{-4}	1.07×10^{-4}	1.01×10^{-4}	0.89×10^{-4}	0.83×10^{-4}	0.62×10^{-4}	0.81×10^{-4}
75° F. to 212° F.	0.95×10^{-4}	1.19×10^{-4}	1.15×10^{-4}	1.10×10^{-4}	0.95×10^{-4}	0.89×10^{-4}	0.86×10^{-4}	0.83×10^{-4}	0.75×10^{-4}
212° F. to 302° F.	0.98×10^{-4}	1.08×10^{-4}	1.02×10^{-4}	0.97×10^{-4}	0.90×10^{-4}	0.69×10^{-4}	0.74×10^{-4}	0.72×10^{-4}	1.08×10^{-4}
Linear shrinkage, %	1.7	2.6	2.1	1.8	1.0	1.7	2.0	1.3	1.7
Compression set, %, (Method B)	7	10	15	22	26	41	—	—	—
(Method A)	—	—	—	—	9	9	7	50	45
Solenoid brittle temperature, °F.	Below −90	Below −90	Below −90	Below −90	Below −90	Below −90	Below −90	−90	−85
Impact resistance, ft.-lb./in.	Flexed	Flexed	Flexed	Flexed	Flexed	Flexed	>20	3	1.2
Abrasion index, Bureau of Standards, %	37	100	145	170	200	375	340	250	275
Tear strength, Graves, pli.	150	175	225	400	550	600	—	—	—
Split, pli.	10	12	25	45	70	155	170	125	175

Electrical Properties	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC	0.1 KC	100 KC
Power factor, %, at 75° F.	2.15	9.50	7.90	5.30	8.20	8.15	5.15	5.55	4.70	5.92	7.25	4.35	7.35	3.45	5.58	3.35	5.80	2.60
158° F.	9.05	6.50	12.10	6.00	13.90	6.55	10.56	4.15	9.45	4.15	6.65	4.75	6.90	3.40	5.47	2.60	7.10	3.05
212° F.	20.07	6.95	—	8.33	9.60	3.60	17.35	4.55	12.60	3.90	8.75	4.00	8.55	4.15	7.20	3.15	8.65	3.35
Dielectric constant (SIC), at																		
75° F.	11.10	9.41	8.02	5.94	8.20	6.25	9.74	7.79	9.37	7.78	9.25	7.58	7.88	6.65	7.21	6.38	7.58	6.40
158° F.	11.83	10.83	12.43	9.58	8.40	7.21	11.86	10.05	11.05	9.62	11.65	9.74	10.34	8.52	8.74	7.48	9.68	8.04
212° F.	12.57	10.80	16.47	10.05	12.70	7.82	12.49	10.41	11.48	9.87	12.19	9.98	11.11	8.75	9.32	7.67	10.50	8.28
DC volume resistivity, ohm-cm. at																		
75° F.	4.3×10^{11}		8.2×10^{12}		4.8×10^{12}		5.0×10^{11}		4.8×10^{11}		3.7×10^{12}		2.7×10^{13}		2.4×10^{14}		2.0×10^{14}	
158° F.	3.9×10^{10}		2.4×10^{11}		1.4×10^{11}		2.8×10^{10}		3.8×10^{10}		2.0×10^{11}		8.2×10^{11}		6.1×10^{12}		3.2×10^{12}	
212° F.	2.9×10^{10}		2.7×10^{11}		1.3×10^{10}		1.7×10^{10}		2.3×10^{10}		1.1×10^{11}		3.6×10^{11}		2.4×10^{12}		1.2×10^{12}	

B. Soft Range

Compound Designation	J	K	L
Durometer hardness	10-15A	30-35A	45A
300% Modulus, psi.	50	40	150
Tensile strength, psi.	300	525	600
Elongation at break, %	900	1000	700
Compression Set, Method B 22 hrs./ 158° F., %	23	34	40
Tear strength, Graves, ASTM D 624, Die C, pli.	<20	<20	50
Brittle point, °F.	<−80	<−80	<−80
Oil resistance	Fair	Fair	Fair

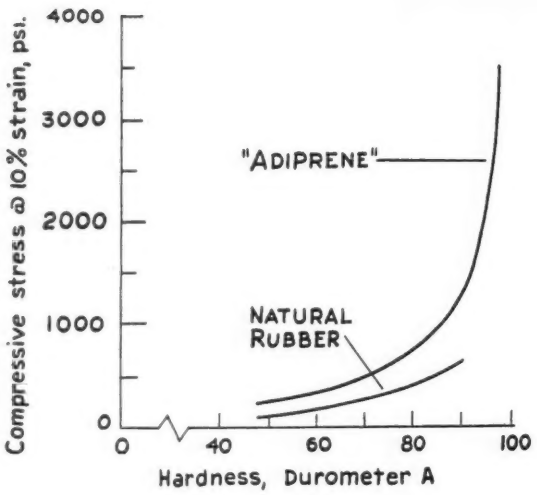


Fig. 2. Load-bearing capacities of "Adiprene" are greater than those of natural rubber, as curves show

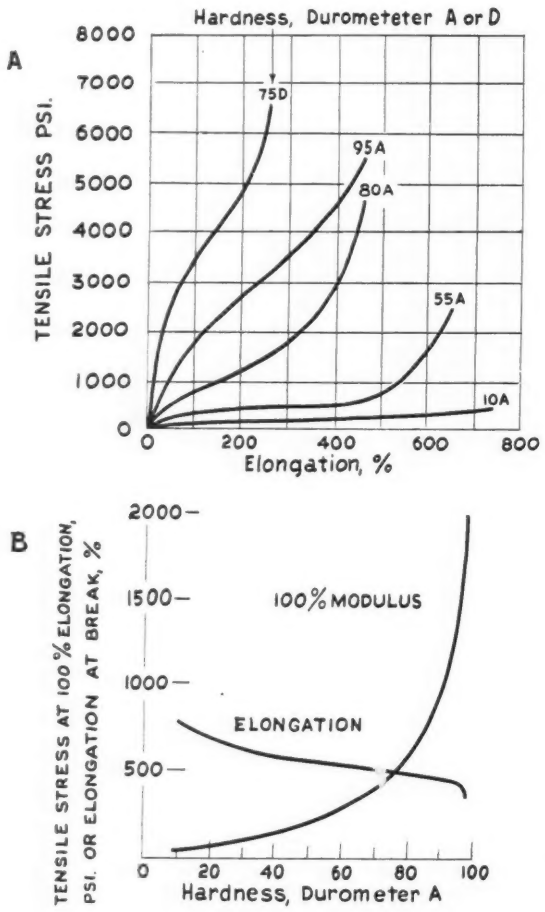


Fig. 3. "Adiprene" urethane products retain considerable elongation as they increase in hardness, a property of urethanes which is unique. Figures A and B show changes in elongation with increasing hardness

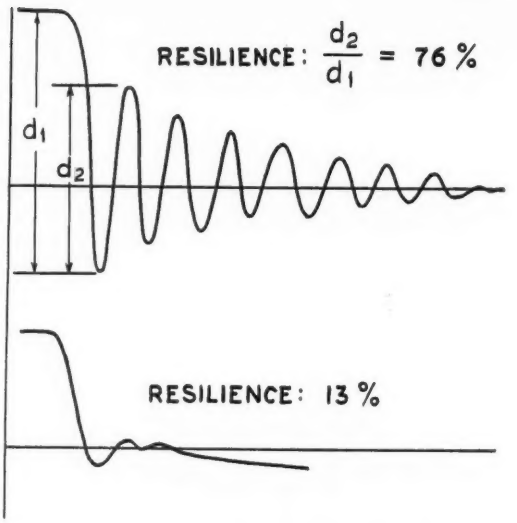


Fig. 4. Yerzley oscillograms of two different compounds of "Adiprene," both of 60 A durometer hardness, show the variation in resilience possible by different compounding

TABLE 2. EFFECT OF CHOICE OF "ADIPRENE" AND CURING AGENT ON PROPERTIES OF HARD POLYMERS

	LD-213 Curing Agent		LD-315 Curing Agent	
	Diamine	Diol	Diamine	Diol
MOCA	X		X	
1,4 Butanediol		X		X
Trimethylol propane		X		
Hardness, durometer A	>96	89	>96	90
D	74	45	79	35
Tensile strength, psi.	7500	5800	10,000	6800
Elongation, %	250	400	270	360
100% modulus, psi.	3500	550	4800	2900
Resilience, rebound, %	48	21	47	20
Compression set, A, 1350 psi., 22 hrs., 158° F., %	54	4	10	51

As shown in Table 2, these products can also be used to illustrate the control of both compression set and resilience which can be achieved by varying either the polymer or the curing agent. With LD-315 and diamine cures it is possible to obtain very low compression set and good resilience combined with extreme hardness. This condition suggests rolling, sliding, and striking applications. The low resilience of the hard diol-cured products of LD-213 suggests their use in applications where damping of vibration and absorption of shock are important.

Vulcanizates with resilience values ranging from 15 to 80% have been prepared from the family of liquid "Adiprene" urethane rubbers. Figure 4 shows the variation in resilience possible with two different compounds at durometer 60A.

In parts made with these polymers, heat build-up

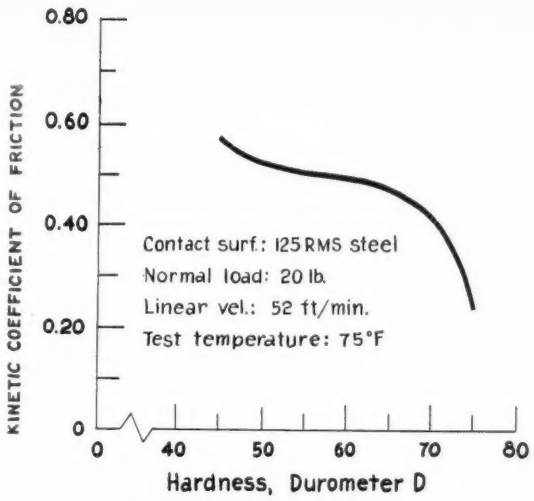


Fig. 5. Coefficient of friction of "Adiprene" elastomers goes down sharply as hardness increases, as this curve shows

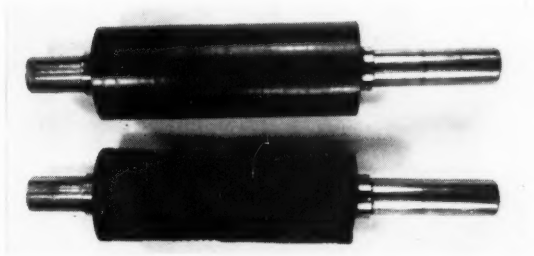


Fig. 6. Showing the abrasion resistance of "Adiprene" urethanes, the "Adiprene" feed roll for plastic strands, *top*, shows little surface wear, though it has been used eight times as long as the natural rubber roll below

when subjected to high-frequency flexing exceeds that of conventional elastomers. Their high strength and load-bearing capacity, however, often enable the use of sections thin enough to dissipate the heat at the same rate it is generated, thereby reducing the chance of failure.

The harder products exhibit surprisingly low coefficients of friction, as shown in Figure 5. Further changes in frictional coefficients can be effected by various compounding techniques.

The high abrasion resistance of products made from liquid "Adiprene" has led to many important applications. These have usually been based on service or simulated service tests, since laboratory abrasion tests can often be misleading. The importance of the service test in defining which type of "Adiprene" to select for a demanding abrasive application cannot be overemphasized (see Figure 6).

A number of important elastomer applications (such as mounting and suspension assemblies) involve loading in shear. The stress-strain curve for "Adiprene" in shear (Figure 7) resembles the tensile and compressive curves: the material shows a very high load-bearing capacity

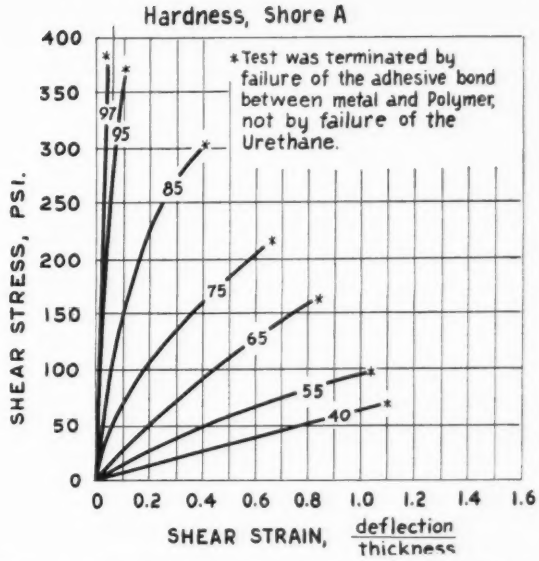


Fig. 7. "Adiprene" shows a very high load-bearing capacity in shear, as these curves for products over a considerable hardness range show

in shear.

"Adiprene" urethane rubbers do not embrittle or crystallize at temperatures as low as minus 80° F. (Below 0° F., stiffening is encountered.) Properly compounded parts, however, have been used in contact with liquid nitrogen and have shown good impact resistance.

Processing Principles

In addition to excellent control of properties, "Adiprene" offers simple, straight-forward processing. The most widely used method of processing involves metering accurately proportioned separate liquid streams of "Adiprene" and curing agent to an efficient mixing head. The effluent liquid product can be cast or molded in many different ways.

The various types of liquid "Adiprene" are readily pumped, transferred by blowing, and metered. The curing agent MOCA, which melts above 210° F., is handled molten in heated reservoirs and heated lines. Overheating should be avoided since decomposition may result.

Bubble-free castings can be prepared from "Adiprene." It is important first to remove dissolved air from the "Adiprene." This can be done batchwise or in a continuous vacuum degassing step using commercially available equipment.

Processing equipment should embody accurate metering (plus or minus 1° F.), close temperature control of feeds (plus or minus 5° F.), provision for draining and solvent-flushing the mixer, and a system of check valves to prevent back-up of process mixtures into feed lines. Adequate commercial units are available; some resemble urethane foam mixers, while others are more like epoxy-resin mixing machines.

Figure 8 shows the importance of precise control of feed ratios in standardizing tensile strength and

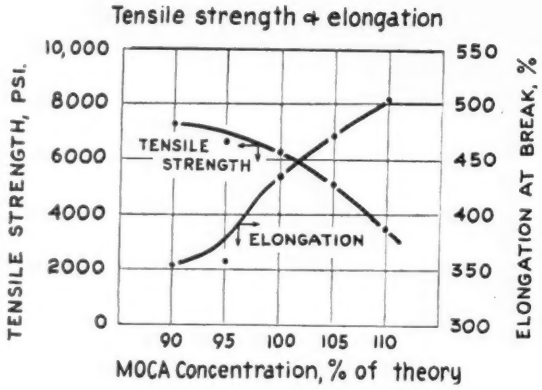


Fig. 8. The variation in properties by varying concentration of curing agent is shown here in tensile and elongation curves of "Adiprene" L-167 cured with MOCA, a Du Pont curing agent

TABLE 3. EFFECT OF CURING TEMPERATURES ON PROPERTIES "ADIPRENE" L-100

Cure temp. °F.	320	285	212	158
Time min.	30	60	180	240
Hardness, durometer A	65	75	88	92
Tensile strength, psi.	3000	4500	5000	4750
Elongation, %	430	430	450	450
Modulus 300%, psi.	750	1100	2100	2350

elongation when curing "Adiprene" L-167 urethane rubber with MOCA. Table 3 provides a further example: the effect of changing the curing temperature for a typical compound of "Adiprene" L-100 with MOCA.

The working or pot life of the reacting mixture is a function of the type of "Adiprene" and the mixing temperature. The hardest types have the shortest pot lives.

Fabrication Techniques

An unusually wide variety of techniques can be used to fabricate parts from the process mixture of "Adiprene" and curing agent. For larger parts—more than one pound of polymer each—open casting into single molds is often most economical. Where it is desirable to obtain excellent definition, closed molds can be used. Pressure is applied after the reacting mixture has gelled to a suitably high viscosity.

Small parts are often cast into multiple cavity molds —either open or compression type. As shown in Figure 9, centrifugal casting and rotational casting can also be used.

Some molders prefer to allow the mixture of "Adiprene" and MOCA to react partially to a "plastic gum" stage. This material is millable and moldable and can even be injection molded. The working life of the "plastic gum" can be extended by refrigeration.

By introducing a chemical blowing agent, microcellular products with high strength and load-bearing

TABLE 4A. COMPARISON OF TWO ELASTO PLASTIC "ADIPRENE" POLYMERS WITH A STRUCTURAL PLASTIC

	Compound A	Compound B	Polyamide Resin
Tensile strength, psi.	9200	10,200	11,000
Elongation at break, %	310	250	300
Yield point, psi.	3500	5200	10,000
Elongation, %	15	20	20
Hardness, durometer D	78	76	80
Tear strength (D-470), pli.	150	115	
Compression set (A), %	54	5	
Flexural modulus, R. T.	103,000	117,000	175–400,000
Izod impact resistance, ft.-lb./in.	2	11	1–2
Heat distortion point at 66 psi., °F.	167	372	360
Specific gravity	1.19	1.19	1.14
Crystalline	No	No	Partly

TABLE 4B. AGED PROPERTIES—COMPOUND B

	Original	Water, 16 Hours, 212° F.	Air One Week, 250° F.
100% Modulus, psi.	5100	2900	4450
Tensile strength, psi.	10,200	7475	8925
Elongation, %	250	290	305
Hardness, durometer A	98	98	95
D	76	70	70

capacity and light weight can be produced.

Systems of "Adiprene" urethane rubber and curing agents can be sprayed in commercial equipment at relatively high solids contents to yield tough, strong films and coatings.

For most applications the parts must be heat-cured. Usual parameters are from 30 minutes at 300° F. to four hours at 160° F. (depending on reacting system and properties desired). In some special cases no cure is required beyond allowing the reactions to proceed at room temperature.

End-Uses of "Adiprene"

Although "Adiprene" is still classified as a new product, it has been adopted for a number of important commercial end-uses. Figure 10 relates the end-uses of "Adiprene" to the appropriate ranges of hardness.

Many applications are in the hardness range traditionally associated with rubber: some solid tires, rollers, rolls, seals, grommets, and a host of other rolling, sliding, sealing, and striking applications.

As noted earlier, the most unusual properties of "Adiprene" are developed in very hard compounds (in contrast to typical rubbers which are at their best in softer ranges). Table 4A shows how two of these hard "elastoplastic" polymers compare with a typical polyamide resin. Important applications for bearings (see hot water aging data, Table 4B) are indicated. Many structural plastic parts which must survive low-temperature impact are also candidates.

Hard products of "Adiprene" are of increasing im-

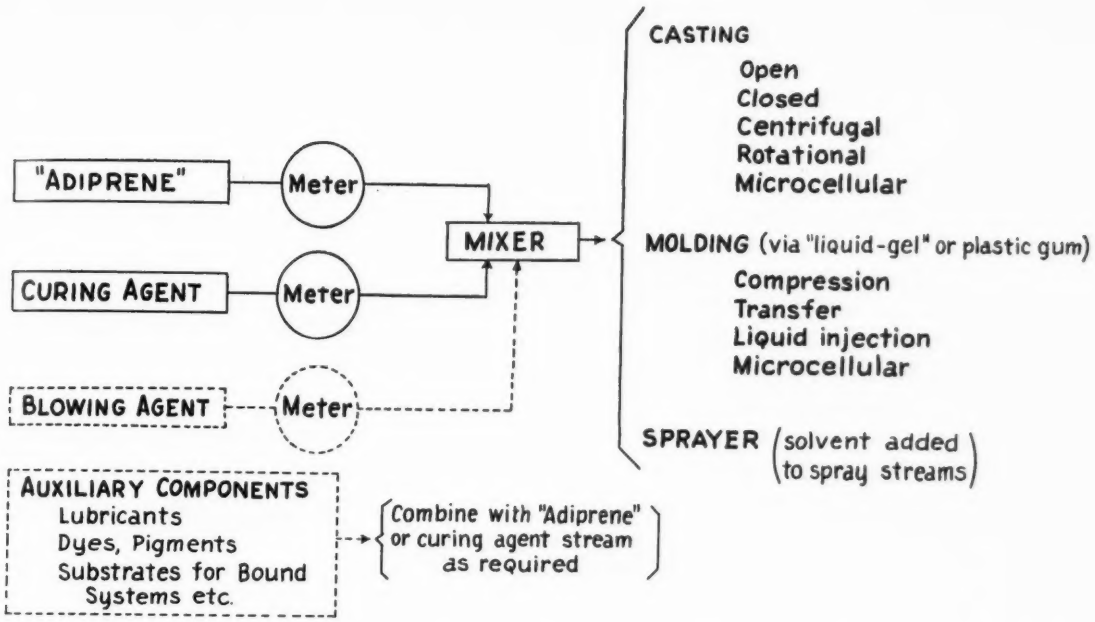


Fig. 9. This flow sheet for "Adiprene" parts shows the variety of fabrication methods possible with the liquid urethane

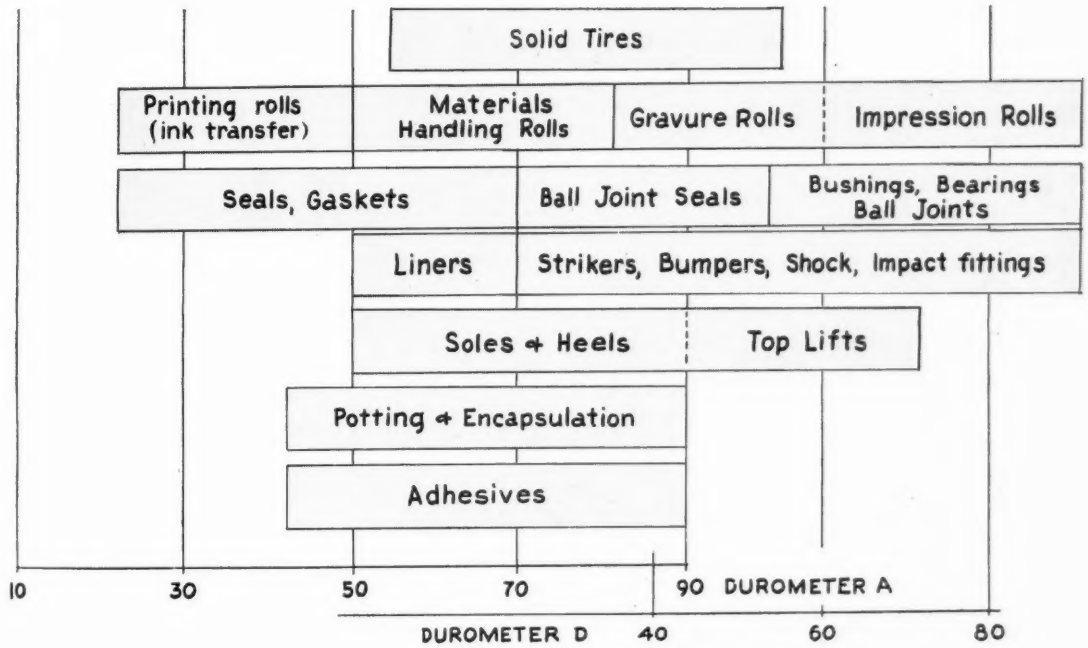


Fig. 10. Hardness range of "Adiprene" urethanes makes possible development of a variety of products from vey soft to very hard, as is shown here

portance in uses such as forming pads and dies in metal-forming operations. Better wear and performance than rubber and better economy than steel are the key features.

Some special end-uses depend on the fluidity of the polymer. Examples are potting and encapsulating electrical components, particularly where a high-strength rubber is required, as in missiles. Blends of "Adiprene" urethane rubber and epoxy resins are miscible and cocurable and show interesting encapsulation properties. Several firms have developed proprietary adhesive systems of "Adiprene" using fast, liquid curing systems. In other uses which depend on the liquid nature of the material, it binds various substrates as varied as ground cork, mag-

netic iron particles, abrasives, and ground leather, to yield gaskets, magnets, grinding units, and other products.

One large commercial application effectively demonstrates the properties of "Adiprene." The tiny top lifts (or heel tips) on the ladies' fashionable stiletto heels receive impacts of several thousand pounds per square inch. Abrasion is severe. Elasticity is required for wearing comfort. Rubbers, leather, and plastics have been replaced in this use by "Adiprene."

The list of applications—pump liners handling abrasive slurries, automotive ball joint seals, duct liners to resist abrasion from air-blown sand, to name just a few—is too long for a brief report such as this.

To summarize, "Adiprene" has replaced rubber, leather, plastics, and steel, but, most important, it allows design concepts which were not possible earlier. It is essential for the designer to regard "Adiprene" urethane rubber as a new material. For best results, design problems should be approached on a fundamental basis rather than by duplicating existing parts.

The versatile family of "Adiprene" polymers lends itself to excellent control of physical properties of end-products and to a variety of fabrication methods. "Adiprene" is a relative newcomer to the plastics and rubber fields which it straddles and is already being employed widely. Interesting new products and techniques are being developed. The skill of the compounder and fabricator is vital to developing its potential.

Texin Urethane Elastomers

(*Continued from page 77*)

will flow into the mold readily. It should have a volume of at least twice that of the article being molded. The ram should displace sufficient materials to fill the mold. When the mold is maintained at room temperature, molding cycles in the order of one minute can be used, followed by an oven postcure.

Storage and Coloring

Storage stability for the Texins is good in spite of the partially cured state. If stored away from heat at room temperature or under refrigeration and in closed, sealed containers, the materials should remain in satisfactory condition for many months. Actual shelf life has yet to be determined under these proper conditions.

A number of coloring materials which were dry blended with the Texins prior to injection molding or extruding gave homogeneously colored products. The dyestuff was used in a concentration of 0.1- to 0.2-part by weight per 100 parts of Texin. White color was obtained with one part to two parts by weight of titanium dioxide to 100 parts of Texin. There is good reason to believe that similar blending could be accomplished by using a dispersion-type nozzle on an injection press.

Use of Texin

Solid urethane elastomers should be considered as engineering materials. They are not substitutes for inexpensive general-use articles, but will perform very well in applications where their special properties are needed.

In considering the practicality of making a particular part from Texin elastomers, thought must be given to the design of the part and use and handling of the grade of Texin. Direct substitution of these materials for previously used materials may not make the best use of urethane properties. By proper design of the part and its mold and proper selection of urethane and processing variables, parts can be made to give outstanding service.

Estane Polyurethanes

(*Continued from page 75*)

shown in the comparison with an electrical-grade vinyl insulation compound, in Table 7.

TABLE 7. ELECTRICAL PROPERTIES OF ESTANE

	Estane 5740X1	Flexible Vinyl
Specific inductive capacity 26° C. at 1000 cycles	11.4	6.1
Power factor 26° C. at 1000 cycles, %	37.5	11.2
Dielectric strength 1 kv/sec. rise, V/mil at 22° C.	550	700
Insulation resistance constant at 15.6° C.	2.75	10,000

Estane's advantage lies in jacketing applications where its combination of low-temperature flexibility, toughness, and ozone, cut, and abrasion resistance surpass any of the thermosetting or thermoplastic jacketing materials commonly used while retaining all of the advantages of thermoplastic processing. Like other polyurethanes, the Estane polymers support combustion, but can be made self-extinguishing by simple compounding methods.

Applications of Estanes

The combination of crosslinked-type polyurethane properties with the thermoplastic ease of processing Estane by molding, calendering, extrusion, and solution techniques has been of interest in a wide variety of applications such as:

1. Jacketing for electrical cable, control cable, and hydraulic hoses.
2. Molded heel lifts, football cleats, and automotive parts.
3. Coatings and finishes for shoes, scuff pads, automotive door welting, paneling, and textiles.
4. Extruded tubing and profiles.

Symposium on Synthetic Elastomers Marks Rubber Division's Fall Meeting

The fall meeting of the Division of Rubber Chemistry of the American Chemical Society will be held with that of the parent society in Chicago, Ill., September 6, 7, and 8, at the Sherman Hotel.

The first day's session, September 6, will be a joint symposium with the Petroleum Division in the grand ballroom of the Palmer House, with W. J. Sparks, Esso Research & Engineering Co., New York, N. Y., presiding.

The morning session will be opened at 9:00 a.m. with session chairman's remarks by H. Gershinowitz, president of Shell Chemical Co., New York. The afternoon session, at 1:30 p.m., will be opened with session chairman's remarks by George R. Vila, president, United States Rubber Co., New York, and closed with a summary by Prof. H. I. Mark, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

The sessions for contributed papers will be held September 7 and 8 in the main ballroom of the Sherman Hotel. W. S. Coe, of Naugatuck Chemical Division, U. S. Rubber, Naugatuck, Conn., chairman of the Division of Rubber Chemistry, will preside over the morning session, September 7, and G. E. Popp, Phillips Chemical Co., Akron, O., division vice chairman, will preside over the afternoon session. T. C. Argue, of Roth Rubber Co., Cicero, Ill., will preside over the final session the morning of September 8.

Registration will be held all day September 5, preceding the meeting. The business meeting of the Division will be held at 11:35 a.m., Thursday, September 7, with business including the award for the best paper at the May, 1960, meeting in Louisville, Ky. Other highlights of the divisional meeting include the luncheon meeting of the Division's 25-Year Club, at 11:30 a.m., September 7 at the Bal Tabarin, Sherman Hotel, with B. W. Lewis, Witco Chemical Co., Chicago, presiding, and announcement of the letter-ballot for officers and directors.

The next meeting of the Rubber Division will be held in Boston, Mass., April 24-27, 1962. According to L. H. Howland, Division secretary, Naugatuck Chemical Division, the deadline for abstracts of papers for that meeting is February 26, 1962.

Program and Abstracts of Papers

Tuesday, September 5
Registration All Day

Wednesday Morning—
September 6
Elastomers from Petroleum Hydrocarbons
W. J. Sparks, Presiding

9:00 a.m.—1. Introductory Remarks. W. J. Sparks.

9:05 a.m.—2. New Developments in Raw Materials for Synthetic Rubbers. H. Gershinowitz.

9:30 a.m.—3. Catalysts for the Polymerization of Isoprene to *Trans*-1,4-Polyisoprene Synthetic Balata). J. S. Lasky,[1] H. K. Garner, R. H. Ewart, U. S. Rubber, Research Center, Wayne, N. J.

A catalyst prepared from aluminum triethyl and vanadium trichloride is reported to polymerize isoprene to *Trans*-1,4-polyisoprene. The efficiency of this heterogeneous catalyst has been increased by a factor of ten or more by supporting the vanadium trichloride on clay to increase its surface area. A further and even more substantial improvement in efficiency was achieved by adding a tetraalkyl titanate as a third catalyst component. This gave a highly active soluble catalyst system for the preparation of synthetic balata. Properties of synthetic balata compared to natural balata are also given.

10:00 a.m.—4. The Polymerization of Butadiene with Alkylaluminum and Cobalt Chloride. Morris Gippin, The Firestone Tire & Rubber Co., chemical and physical research laboratories, Akron.

Diethylaluminum chloride-cobalt chloride catalyzed polybutadiene having 98% *cis*-1,4 structure has been reported in the literature. Detailed studies in this laboratory have established that, contrary to published data, the diethylaluminum chloride-cobalt chloride system requires a narrow ratio of water as a third component before it can function smoothly and efficiently. The soluble diethylaluminum chloride combination with low amounts of pyridine-complexed cobalt chloride also requires water.

At the optimum ratios of the alkylaluminum, cobalt chloride, and water, polybutadiene of 98% *cis*-1,4 content, 5 to 7 dilute solution viscosity and zero gel were obtained. Polymer viscosity is inversely proportional to the cobalt chloride-pyridine concentration and varies directly with the water concentration. Within certain limits the *cis*-1,4 content varies inversely with the cobalt chloride-pyridine and directly with the diethylaluminum chloride concentrations.

Changes in the monomer concentration in benzene has a pronounced effect on polymer molecular weight and gel formation and also affects the microstructure. Certain organic derivatives of water failed as substitutes, but aluminum trichloride can be used to replace water on an equimolar basis. The *cis*-1,4 content decreases at higher polymerization temperatures. Polymer molecular weight was lowered by the use of higher pyridines of cobalt chloride and by mixtures of benzene and hexane as polymerization solvent. The rate of polymerization is linear with time in the early stages and appears to be first order with respect to monomer at a fixed catalyst concentration. The requirement of the water component with diethylaluminum chloride and cobalt chloride eliminates the uncertainty factor in this catalyst, which otherwise depends on adventitious moisture or oxygen to give variable, non-reproducible results.

10:30 a.m.—5. Inorganic Halides in Vinyl Pyridine Rubber. W. F. Bruckseh, Jr., U. S. Rubber, Research Center.

Pyridine rubber is a diene synthetic rubber very resistant to abrasion. The reactions of pyridine groups, therefore,

[1]Author's name in bold face indicates person presenting paper.

may contribute to physical properties. One reaction to consider is formation of coordination complexes.

This study was made to determine whether inorganic compounds known to coordinate pyridine also interact with pyridine rubber. It has been found that pyridine rubber is made stronger by adding certain inorganic halides. A kind of crosslinking results, probably by coordination of pyridine nitrogens. The product has improved physical properties: gum stocks show higher tensile strength; filled stocks show higher tensile strength and elongation at 100° C. and greater resistance to abrasion and to cut-growth.

The system also has the capacity to develop high modulus. Because of this, lower amounts of filler may be used. The result is a compound which has hysteresis properties like a carcass stock and abrasion resistance like a tread stock.

11:00 a.m.—6. Chlorobutyl Rubber—Processing Improvement. G. J. Ziarnik, Esso Research & Engineering, chemicals research division, Linden, N. J.

The chlorination of butyl rubber has produced a new butyl elastomer (Enjay Butyl HT10-66) with faster cure rate and greater crosslink stability. Because of this increased reactivity, however, chlorobutyl generally requires the addition of basic materials such as MgO to control scorch during processing. Since these basic materials can also retard vulcanization, some cure rate advantage for the chlorinated polymer is sacrificed. This paper will show that cure retardation can be reduced, while still maintaining good scorch safety, by heat treating.

Process studies have revealed that MgO may retard polymer-pigment interaction as well as vulcanization. The former effect, moreover, may be as important as the latter. Both retarding effects are reduced by heat treating. Higher process temperatures may produce changes in polymer and MgO reactivity which reduce their effectiveness during the vulcanization process. These changes are consistent with reactions of such chemical species. At the same time, higher temperatures promote polymer-pigment reinforcement which apparently may not take place to any great extent during cooler mixing or vulcanization in the presence of MgO. The effect of MgO and processing temperature on the properties of both chlorobutyl gum and carbon black systems will be discussed.

11:30 a.m.—7. Anionic Polymerization of Dienes. Maurice Morton, Institute of Rubber Research, University of Akron, Akron.

Although the polymerization of dienes by alkali metals has been known for many years, it is only recently that a fuller understanding of the process has been achieved. The initiation reaction is now considered to consist of an electron transfer from the metal surface to the monomer, leading to formation of a radical anion. The latter may then form a di-anion by reacting with a similar species, or it may do so by undergoing a second electron transfer from the metal surface. Which of these reactions occurs depends on the reactivity of the metal, its surface area, and the type of solvent used. For the least active metal, lithium, it is possible to have a longer lifetime of the intermediate radical anion, during which time both radical and anionic polymerization may go on.

The Ziegler-Natta catalysts lead to polymerizations involving initiation, propagation, and termination steps, with regeneration of the catalyst surface. Therefore, although the conversion increases with time, the molecular weight need not. The soluble anionic initiators, on the other hand, such as sodium naphthalene or the organo-lithium compounds, show initiation and propagation, but no termination or transfer when suitable precautions are taken. Hence it is possible to have all the chains growing simultaneously, provided the initiation reaction is very fast compared with propagation. A very sharp molecular weight distribution may thus be obtained, unlike the case of the alkali metals, where initiation goes on at the metal surface throughout the polymerization, leading to a broad molecular weight distribution.

The homogeneous anionic polymerizations of dienes (and styrene) show a marked dependency of rate on solvent present. This is considered due to the nature and reactivity of the carbanion-lithium bond. Thus, in tetrahydrofuran, the anion is presumably "free" and more active; whereas in hydrocarbon solvents it is bound in an associated complex and is much less active. This condition is reflected by the activation energy for propagation, which is three times higher in hydrocarbon solvents than in THF.

Wednesday Afternoon—September 6
W. J. Sparks, Presiding

1:30 p.m.—8. Revolution in Elastomers. George R. Vila.

2:00 p.m.—9. New Vulcanizing Systems for Ethylene-Propylene Elastomers. Peter E. Wei and John Rehner, Jr., Esso Research & Engineering, chemicals research division.

The absence of chemical functionality in ethylene-propylene elastomers precludes crosslinking with conventional rubber vulcanizing agents. It is known that such elastomers can be vulcanized with combinations of sulfur and certain organic peroxides, but the resulting vulcanizates leave much to be desired from the standpoint of tear strength, odor, and peroxide cost. A chemical study of the reaction between isoparaffins, sulfur, and organic peroxides gave results showing that some important alterations must be made of previous views that have been advanced for the vulcanization of saturated hydrocarbon elastomers by peroxides alone.

A new reaction scheme is briefly reviewed. In the course of this study, three new classes of substances have been discovered to be effective vulcanizing agents for ethylene-propylene elastomers, and also for other rubbers. The outstanding characteristics which these new agents produce in ethylene-propylene elastomer vulcanizates are excellent tear strength and no objectionable odor. Data are presented on some properties of vulcanizates prepared with these agents.

2:30 p.m.—10. Vulcanization of Chlorinated Ethylene-Propylene Copolymers. G. Crespi, M. Bruzzone, Instituto di Chimica Industriale del Politecnico Milano, Milan, Italy.

The chlorination of the ethylene-propylene copolymer constitutes the first step of a process we studied in order to make this polymer vulcanizable by means of the vulcanizing and accelerating agents usually employed in the rubber industry.

The subsequent step, consisting of a partial dehydrochlorination of the polymer, determines the formation in the chains of double bonds; therefore, in the presence of sulfur and of suitable accelerating agents, the formation of crosslinks occurs.

Dehydrochlorination and vulcanization of copolymers with a chlorine content from 5-20% are effected simultaneously, because dehydrochlorination, occurring during the thermal cycle of vulcanization, is sufficient to allow a complete crosslinking of the polymer.

Under these conditions dehydrochlorination is generally limited to tertiary chlorine or, in any case, to the amount of thermally less stable chlorine, which constitutes a determined percentage of chlorine introduced in the polymer.

The properties of ethylene-propylene copolymers are remarkably modified by the introduction of chlorine in the chains. Even small amounts of halogen exert an influence on the dynamic properties of the polymer. Greater amounts of halogen transform the initial polymer, which is prevailingly elastic, into a prevailingly plastic one. With a further increase of the chlorine content in the copolymer, more and more rigid substances are obtained until hard and fragile material is obtained. Data on vulcanization and compounding variables are reported in this paper along with physical properties of the vulcanizates.

3:00 p.m.—11. Chemical Aspects of Ethylene-Propylene Rubber Vulcanization with Aralkyl Peroxide and Co-

agents. **A. E. Robinson,** J. V. Marra, and L. O. Amberg, Hercules Powder Co., Wilmington, Del.

Owing to its characteristic paraffin inertness, ethylene-propylene rubber (EPR) poses a difficult vulcanization problem. The best practical solution to date is a process based on aralkyl (or alkyl) peroxide.

The peroxide vulcanization process is a sequence of free-radical reactions involving initiation, transfer, and termination steps. The rate-determining reaction is thermal cleavage of the peroxide. Crosslinking efficiency in EPR is an inverse function of the propylene content. (Efficiency is defined as the ratio of actual to theoretical crosslink density, based on a theoretical crosslink productivity of one crosslink per molecule of peroxide.) Betascission of the rubber molecule is apparently the main efficiency-reducing factor.

Three approaches are recognized for improving the crosslinking efficiency: (a) reduction of the propylene content of the copolymer; (b) suppression of the copolymer scission reaction; (c) improvement of the crosslink productivity above one crosslink per molecule of peroxide.

Requirements other than vulcanization efficiency (e.g., processability requirements) limit the reduction of propylene content. A copolymer of 33 mole-% propylene is a tentatively favored compromise for many purposes. The crosslinking efficiency of the 33% copolymer with dicumyl peroxide alone is approximately 65% of the theoretical.

Both suppression of scission and improvement of crosslink productivity may be achieved, it appears, by means of coagents which react additively with rubber radicals. Two mechanisms of coagent reaction are envisaged. With agents of a class typified by quinone dioxime, a mechanism is envisaged wherein addition of the rubber radical is fast, and the polymer scission reaction is substantially forestalled. Resonance-stabilized intermediate radicals are produced which may ultimately crosslink by coupling. Crosslinking efficiency may be increased to 100% (no higher) by these coagents.

By an alternative mechanism, coagents of the divinyl adipate type form comparatively reactive intermediate radicals which may propagate themselves by hydrogen abstraction. Multifunctionality is required of the coagent for crosslink formation by this mechanism. Radicals, however, are not consumed. Thus crosslinking efficiency may theoretically exceed 100% with these agents.

The effect of elemental sulfur, a coagent of the quinone dioxime type, is partly offset by a wasteful reaction with peroxide. The great beneficial effect of sulfur on the performance characteristics of peroxide-cured EPR may be attributed partly to the inherent quality of sulfur crosslinkages. The stoichiometric relation of bound sulfur to peroxide in cured EPR suggests that linkages up to trisulfide may be formed.

3:30 p.m.—12. Ethylene-Propylene Copolymers Produced with Soluble Catalysts. R. J. Kelly, H. K. Garner, H. E. Haxo, W. R. Bingham, U. S. Rubber, Research Center.

Soluble catalyst systems derived from alkyl aluminum halides in combination with vanadium oxytrichloride or tetrachloride produce highly random ethylene-propylene copolymers with high catalyst efficiency. By the choice of the alkyl aluminum halide and molar ratio of aluminum to vanadium, variations in polymerization efficiency and molecular weight are possible. The copolymers prepared with these soluble catalysts show advantages in both processing and physical properties over those prepared with heterogeneous catalysts. Vulcanizates of these copolymers show somewhat different accelerated aging properties depending on the additives used along with the peroxide. Low-temperature properties of copolymers containing less than 70 weight % propylene show a tendency for crystallization not shown by X-ray diffraction. Overall physical properties and tire tests show some preference for the 65 weight % propylene copolymer over the 50% material.

4:00 p.m.—13. A New Hydrocarbon Elastomer—I.[2] **E. K. Gladding,** B. S. Fisher, J. W. Collette, and coworkers, E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington.

Sulfur curable elastomers derived from olefins and diolefins will be described. This paper is concerned with the composition of the polymers and methods for their synthesis using coordination catalysts. Certain factors which influence the laboratory-scale polymer synthesis will be discussed also. Thus the effects of catalyst type, polymerization temperature, and diene structure on the rate of polymer formation and on polymer composition will be outlined. Polymer properties will be discussed in general terms, with particular emphasis on oxidative stability.

4:30 p.m.—14. A New Hydrocarbon Elastomer—II.[2] J. J. Verbanc, M. S. Fawcett, E. J. Goldberg, and coworkers, Du Pont elastomer chemicals department.

A new hydrocarbon elastomer synthesized from petrochemical intermediates using coordination catalysis is described. This amorphous polymer (a) resembles commercial diene elastomers in general appearance, (b) is completely soluble in hydrocarbon and chlorinated hydrocarbon solvents, and (c) is stable to prolonged storage. It can be vulcanized effectively by the use of accelerated sulfur systems and reinforced by numerous fillers such as carbon blacks, clays, and certain silicas. Reinforced vulcanizates are strong, resilient, and extremely resistant to oxygen, ozone, heat, light, and many chemical agents. Properly compounded vulcanizates exhibit excellent electrical and low-temperature properties. Permeability to gases, specifically nitrogen, oxygen, and carbon dioxide, parallels that of natural rubber. Thermal diffusivity and thermal conductivity are 15% greater than polyisoprene. The practical significance of the thermal data remains to be determined.

4:50 p.m.—15. Summary of Developments. H. E. Mark.

Thursday Morning—
September 7
Contributed Papers
W. S. Coe, Presiding

9:05 a.m.—16. Effect of Block Structure in Ethylene-Propylene Rubber on Processability and Physical Properties. C. E. Scott, AviSun Corp., Marcus Hook, Pa.

Ethylene-propylene rubber can be prepared in a variety of ways. The resultant copolymers are often quite similar in molecular weight and ethylene-propylene content. However, examination and characterization of these materials by differential thermal analysis indicates that micro-structures differ. The presence of block structures (either ethylene or propylene) promotes orientation and crystallization in the polymer upon milling at 260-270° F. Shear stability of the polymers is not noticeably affected by quantity of block structure. However, compounding ethylene-propylene rubber with a reinforcing carbon black such as Philblack O results in an excessive stiffening if the base rubber contains excessive quantities of block structures. Vulcanizates are prepared using 2,5-dimethyl-2,5 di (t-butylperoxy) hexyne-3 as the crosslinking agent. Mechanical properties of the vulcanizate are also influenced by the amount of block structure. Increasing quantities of block structure result in a vulcanizate having reduced tensile, increased hardness, and high permanent set. Low-temperature and hysteresis properties are also adversely affected.

9:25 a.m.—17. Unsymmetrical Diisocyanates—II. L. C. Case, Purdue University, Department of Chemical Engineering, Lafayette, Ind.

Isocyanate groups in aromatic diisocyanates with unsymmetrically placed substituents react at different rates. In particular, aromatic isocyanate groups having a single ortho substituent react appreciably slower than unsubstituted aromatic isocyanates. The purpose of this research was to investigate the re-

[2] Contribution No. 112 of the Du Pont elastomer chemicals department.

action rates of aromatic diisocyanates having one isocyanate group flanked by two ortho substituents.

Seven such diisocyanates were synthesized, and their reactions with isoamyl alcohol in chlorobenzene determined by following the disappearance of the isocyanate bond in the IR spectrum. Whereas the ratio of apparent rate constants varied from 3 to 9 for singly hindered diisocyanates, the ratio for these doubly hindered diisocyanates varied from 7 to 100. There was no immediate correlation of reactivity ratio with structure among these latter diisocyanates.

Several of the doubly hindered diisocyanates can be readily synthesized at relatively low cost. These isocyanates with large differences in reactivity between the two groups allow a considerable degree of control over polyurethane formulations. Thus "tailored" formulations using such diisocyanates are of theoretical and practical interest. The advantages of such diisocyanates in specialty elastomer, adhesive, and coating formulations are discussed.

9:45 a.m.—18. Compounding of Hydrocarbon Elastomers for Potential High-Temperature Applications. J. K. Sieron and K. Murray, Non-Metallic Materials Laboratory, Wright-Patterson Air Force Base, Dayton, O.

Research indicates that certain hydrocarbon-type elastomers which have the important property of high strength at elevated temperatures can be stabilized by the use of selected additives to permit extended use in the 400-450° F. range. The studies include butyl, chlorobutyl, and two types of ethylene-propylene elastomers.

An example of what can be accomplished by compounding techniques is illustrated by the chlorobutyl study. The data indicate that an unstabilized zinc oxide-phenolic resin-cured chlorobutyl rubber compound retained only about 35% of its original tensile strength after aging eight hours in an air oven at 400° F.; whereas the same compound, when stabilized, retained about 75% of its original tensile strength.

Elastomeric materials which possess high strength at elevated temperatures are required by the Air Force for advanced system components. Hence, emphasis was directed to evaluations at 400° F. and above.

10:00 a.m.—19. Compounding of *Cis*-1,4-Polybutadiene for Pneumatic Tire Applications. R. J. Brown, J. F. Kerscher, R. B. Knill, and R. V. Todd, Goodyear Tire & Rubber Co., Akron.

Budene 500, a high *cis* polybutadiene, provides the compounder with a new versatile tool in all phases of pneumatic tire compounding.

Owing to the unique nature of this rubber, new compounding techniques are required to obtain optimum performance in tire applications. Oil level, type of black, and type of acceleration have pronounced effects on performance.

In tire treads, *cis*-1,4-polybutadiene provides improved wear and tread cracking resistance in proportion to the ratio of polybutadiene/conventional polymers.

When substituted for natural rubber, *cis*-1,4-polybutadiene improves carcass durability owing to its superior aging resistance and high resilience characteristics.

The combination of good abrasion, excellent aging, and good heat resistance of Budene 500 offers possibilities of improved tire performance in both passenger and truck sizes.

10:30 a.m.—20. Development of a Reinforcing Resin for Butyl Rubber and Other Specialty Elastomers. G. B. Freda and R. L. Stukey, Marbon Chemical Division, Borg-Warner Corp., Washington, W. Va.

Conventional styrene-butadiene copolymer resins are widely employed as processing aids and reinforcing resins in SBR and natural rubber compounds, but, in general are unsatisfactory for compounding with elastomers having little or no unsaturation, such as butyl rubber or "Hypalon." This condition is primarily attributed to the wide differences in cure rates and incorrect compatibility between the resins and the elastomers.

A new type of styrene-based resin has been developed that is completely saturated, has the proper compatibility, and is not deleterious to the cure, thus overcoming the problem. Other important properties are good physical form, light color, low specific gravity, and adaptability to a wide range of curing systems. Now, for butyl, "Hypalon," brominated butyl, chlorobutyl, and neoprene, the rubber compounder can obtain the advantages of hardness, reinforcement, and processing that were formerly available only in compounds of styrene-butadiene resins and general-purpose elastomers.

10:45 a.m.—21. Transition Measurements Using Differential Thermal Analysis (DTA) Techniques. Mark L. Dannis, B. F. Goodrich Research Center, Brecksville, O.

A system for the study of polymer structure by differential thermal analysis techniques is presented. The need of an inert reference body has been eliminated by the use of a thermal delay within the sample itself. Typical data showing both first- and second-order transition behavior for appropriate polymers are presented. The applicability of the technique to liquids is also shown.

Three first-order transitions have been found in *trans*-1,4-polybutadiene. The insoluble nature of high polymers in one another is again confirmed, even in those systems which disperse well. The latent heat of crystallization of *cis*-1,4-polybutadiene is about 2.1 kcal./mol.

11:00 a.m.—22. Use of Differential Thermal Analysis for Structural Characterization of Ethylene-Propylene Rubber. J. R. Knox, AviSun Corp.

Differential thermal analysis has been used for the examination and characterization of ethylene-propylene rubbers. The glass transition temperature may be used to determine the % propylene in the random portion of an ethylene-propylene copolymer, independent of any ethylene or propylene blocks. If ethylene or propylene crystallinity is present, the amount may be calculated from the area under the melting peaks observed on the thermogram. The presence of non-crystalline ethylene blocks or propylene blocks may also be observed. Some data are presented indicating that the type of non-crystalline propylene block, isotactic or atactic, may be determined.

11:15 a.m.—23. Identification of Rubber Elastomers by Mass Spectrometry. J. K. Phillips, Goodyear research laboratory, Akron.

The urgent need of a rapid means of identifying rubber elastomers in rubber compounds led to this investigation of instrumental analysis of high polymers.

A new procedure has been developed whereby the identity of a rubber elastomer or elastomers in a rubber compound can be made within a few minutes by the use of a mass spectrometry and high-temperature pyrolysis.

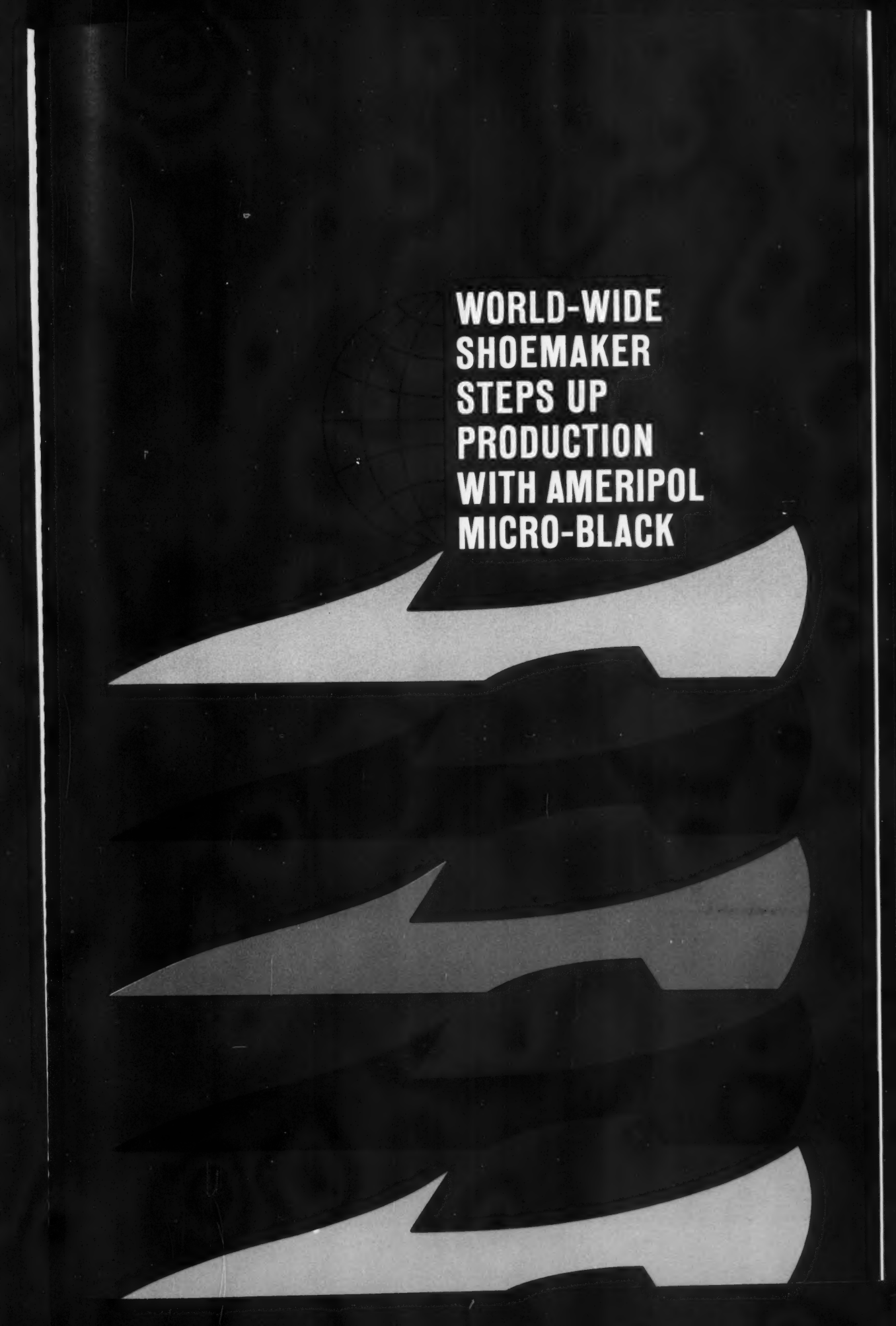
The analytical procedure is simply a rapid high-temperature pyrolysis of a few milligrams of the sample, in vacuo, on an arc-imaging furnace, followed by an analysis of the gaseous pyrolyzate on a mass spectrometer. The exposure time normally used is two seconds on the arc-imaging furnace which is capable of attaining a black body temperature of 6000° F. The total elapsed time for analysis including loading of the sample, evacuation, pyrolysis, and scanning on the mass spectrometer is approximately 20 minutes.

The identifications are made by the use of numerical values obtained from empirical formulae. These formulae were derived from ratios of intensities at certain mass numbers in the mass spectrum of standard samples.

These numerical values, when plotted against known mixtures, also permit semi-quantitative determinations on mixtures of certain rubber elastomers. Semi-quantitative determinations have been made on natural/SBR, natural/*cis* PR, and SBR/*cis* PB compounds.

Qualitative analyses have also been made on various textile polymers, including a distinction between nylon 6 and nylon 66.

It is felt that this new and rapid procedure for identifying rubber elas-


WORLD-WIDE
SHOEMAKER
STEPS UP
PRODUCTION
WITH AMERIPOL
MICRO-BLACK

BATA SHOE CUTS RUBBER MIXING TIME 20%...SAVES ON FINISHED COMPOUNDS WITH AMERIPOL MICRO-BLACK

With 64 plants, 13 tanneries, almost 4000 retail outlets, Bata Shoe Company rightly earns the title of "Shoemaker to the World." To cut production costs at their giant Belcamp Maryland plant, Bata switched to Goodrich-Gulf masterbatch.

Here's why. When using free black for their winter line of footwear, color contamination caused serious delays. Whenever a light color run followed production of black items the line had to be shut down while equipment was laboriously cleaned. A time-consuming messy job.

By changing over to Micro-Black the most delicate pastel shades can follow black with no contamination problem. Equipment, employees and production line stay clean.

That's not all. Mixing time has been cut from a two-stage to a one-stage operation, saving as much as 20% in time.

Whether you manufacture shoes, tires, camelback, coated fabrics or any other black rubber product, you will find Ameripol Micro-Black paying off in three ways.... in production by eliminating weighing and milling operations plus shortening mixing time... in storage by eliminating in-plant handling of carbon black ... in products by assuring thorough dispersion of carbon black in the rubber for increased abrasion resistance, lower heat build-up.

Goodrich-Gulf Chemicals, Inc.

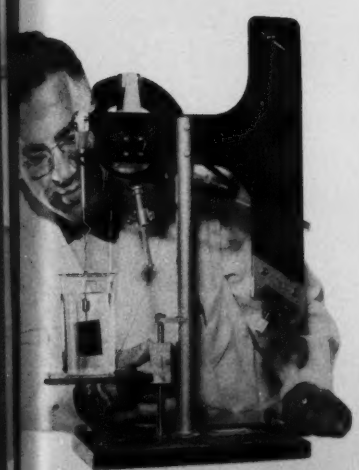
WORLD'S LARGEST SOURCE OF SYNTHETIC RUBBER

Tests prove Goodrich-Gulf Masterbatch Stronger

Using controlled laboratory procedures, Bata Shoe proved that the physical properties of Ameripol Micro-Black were superior to the old free mixing compound. Here are some of the critical tests in that research program:

MOONEY TEST of uncured stock det mines viscosity and cure rate. Ameri 1605 showed a more continuous uniform of plasticity than dry-mix rubbers.

PECIFIC GRAVITY TEST. Here Mr. H. insel, Development Chemist, deter- ines the pound volume ratio of meripol with precision accuracy.



DE MATTIA FLEX TEST shows that products using Ameripol 1605 have from 15-20% better flex life than those made from dry-mix masterbatch.

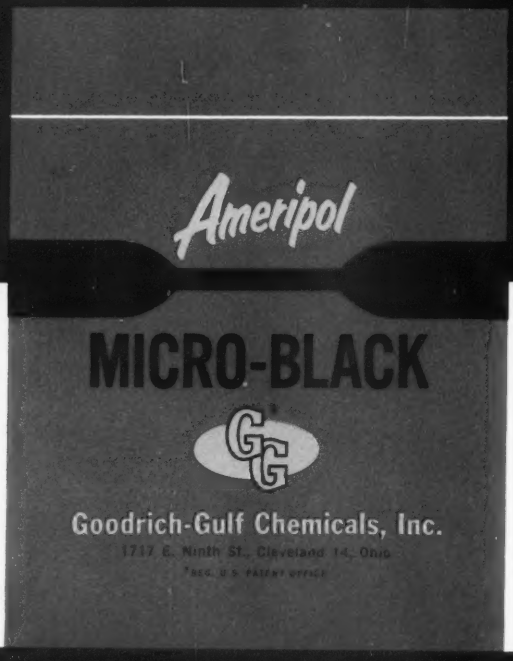
INSPECTION OF FINISHED PRODUCT indicates that this boot, like all footwear made with Ameripol masterbatch, features superior flexibility for longer wear.

Star Performer at Bata Shoe: Ameripol 1605 Black Masterbatch

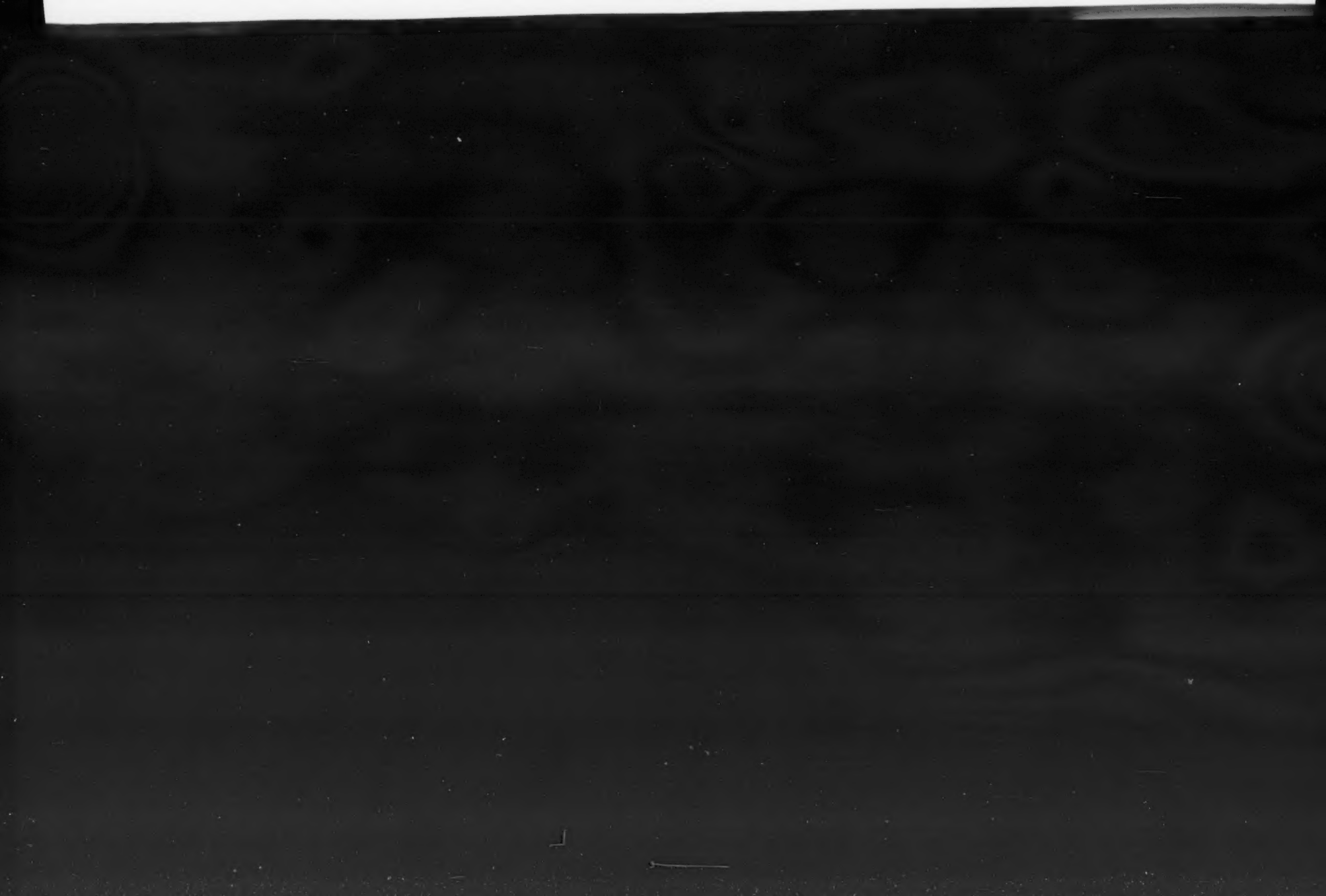
After careful examination and tests Goodrich-Gulf and Bata agreed that Ameripol 1605—a high dispersion carbon black masterbatch — would best meet shoe production needs. And Micro-Black's performance has lived up to its reputation!

CHOOSE FROM 14 TYPES OF MICRO-BLACK

One is ideally suited to boost your rubber processing efficiency. To put Micro-Black to work on your production line call your Goodrich-Gulf Sales Engineer. Or write us at 1717 East Ninth Street, Cleveland 14, Ohio.



New Unit Pack stacks easily ... prevents contamination in shipment. Cap and sleeve construction prevents grain, dust or wood contamination. Easy to double stack ... permits four-way entry with fork trucks.



tomers and other polymers will prove to be a valuable tool to rubber chemists and technologists in general.

11:30 a.m.—Luncheon-Meeting of 25-year Club. B. W. Lewis, presiding.

11:35 a.m.—Business Meeting. Chairman W. S. Coe, presiding. Best paper award from Louisville meeting. By-laws. Necrology.

Thursday Afternoon—
September 7
Contributed Papers
G. Popp, Presiding

2:00 p.m.—24. "Blow-Point" in Tire Compounds. H. A. Freeman, Goodyear.

Since the advent of faster tire cures, particularly in bladder presses, it becomes increasingly important to know at what point in the curing process the tire compounds would blow or give porosity at pressure release. The tire cure then must proceed well beyond that blow-point before pressure release.

A laboratory method has been developed to indicate the blow-point of tire compounds.

For test, six- by six-inch rubber blocks are prepared with built-in thermocouples through the center. One block has two plies of calendered fabric and the other has four plies. On to a 0.15-gage sheet cured bladder stock are placed two and four plies of calendered fabric. The inch-deep mold is then filled with tread stock. Thermocouples are placed between each sheet and up into the tread. Test blocks are then cured, and equivalent cure determined at each station.

Non-thermocoupled test pieces are cured at times near the suspected blow-point. They are then cut through the center and examined for blows or porosity.

Some tests, such as hardness, adhesion (ply stock to tread), swell, and modulus on the specimens, were tried, but these must include cooling cure after pressure release.

Results indicate that the blow-point on tire tread compounds is at somewhat less than 25% of optimum cure for a given compound.

The laboratory tests were compared with actual tire cure and found to have close correlation.

2:25 p.m.—25. Improvements in Durability of Natural Rubber Vulcanizates. G. F. Bloomfield, M. Braden, J. R. Dunn, S. G. Fogg, M. W. Philpott, Natural Rubber Producers Research Association, Welwyn Garden City, Hertz., England.

In compounding rubbers for maximum life at high temperatures the established preference for "sulfurless" curing systems has been placed on a sound scientific basis, and with an understanding of the principles involved further improvements have been forthcoming. Not only can their effectiveness be enhanced by selected antioxidants, but activation by substances capable of participation in thioanion-disulfide interchange enables thiuram curing systems to function at temperatures of 100° C. or even lower. The activated cures can be used advantageously in latex processes giving marked improvements in heat aging.

The protection of translucent vulcanizates against light presents a special problem since some amines which protect against thermal degradation photosensitize aging in light. Stress relaxation studies have revealed that a mixture of a substituted bis-phenol and a light absorber gives good protection.

Two entirely different modes of action have been recognized among the many unrelated substances providing varying degrees of protection against ozone. The more important class of aniozonants, the N N′-dialkyl *p*-phenylene diamines, raise substantially the critical stored energy required for crack growth; several other types of antiozonant chemicals (including 6-ethoxy-2,4, 4-trimethyl-1,2 dihydroquinoline) merely decrease the rate of crack growth. The N N′-dialkyl-*p*-phenylene diamines give adequate protection under static conditions; under intermittent dynamic conditions involving both ozone and fatigue good protection is given by N-alkyl-N′-aryl *p*-phenylene diamines plus wax, but the best results are obtained by admixture of one of these unsymmetrical *p*-phenylene diamines with N N′-dialkyl-*p*-phenylene diamine.

2:45 p.m.—26. Temperature Coefficient of Vulcanization for Present-Day Tire Compounds. J. C. Ambelang, K. C. Beach, D. F. O'Sullivan, Goodyear.

The rate of change of vulcanization rate with temperature has been widely assumed to be 1.5 per 10° F. even though it has been recognized that the value is not constant. Since the above value was experimentally established for *Hevea* rubber, synthetic rubbers, furnace blacks, delayed-action accelerators, and high-temperature cures have profoundly altered the composition and cure conditions of tire compounds.

Development of the physics of high polymers indicates a fresh look at the methods of cure evaluation and at such concepts as "optimum" cure. The measurement of cure state has now been based on: (a) degree of crosslinking —from swell measurement; (b) modulus at 100% elongation; (c) modulus at 300% elongation. While the last is the least desirable in theory, it is the most familiar and practical in rubber manufacturing. For representative tread-type compounds in the region of 80% of maximum modulus the mean values obtained were: *Hevea*, 1.4; SBR, 1.3; *cis*-polybutadiene, 1.4.

The above coefficients were corroborated by means of 100% modulus and crosslinking data and were verified by comparing predicted moduli with experimental values.

Since these values are lower than 1.5, more nearly equivalent state of cure can be reached if the new experimental temperature coefficients are employed in calculating the time required at different temperatures.

3:05 p.m.—27. DPG (Diphenylguanidine) Accelerated Vulcanization. I. Gum Stocks. Merton L. Studebaker and Lester G. Nabors, Phillips Chemical.

A study has been made of the vulcanization of DPG-accelerated, sulfur-cured natural-rubber gum stocks. The chief tools employed are crosslink measurements by the swelling procedure and group analyses in which the vulcanizates are reduced with lithium aluminum hydride and the reduced samples titrated potentiometrically for sulfide and mercaptan.

DPG, zinc oxide, and stearic acid are shown to exert readily demonstrable influence on the polysulfide crosslink density and hence upon the total crosslink density. The rate of formation of polysulfide crosslinks is markedly influenced by the DPG level.

3:25 p.m.—28. DPG (Diphenylguanidine) Accelerated Vulcanization. II. Carbon Black Stocks. Merton L. Studebaker and Lester G. Nabors.

The influence of DPG, zinc oxide, and stearic acid on the vulcanization of natural rubber in the presence of the HAF black, Philblack O, was similar in many ways to their influence on gum stocks. However, the apparent crosslink densities, as calculated from swelling measurements, were markedly increased.

When simple DPG-accelerated natural-rubber vulcanizates were prepared containing a variety of types and loadings of carbon blacks, certain chemical effects could be observed which can be related to the properties of the various carbons. The quinone content of the various carbon blacks is particularly important in determining the rate at which polysulfide crosslinks develop, especially in the early stages of cure.

3:45 p.m.—29. DPG (Diphenylguanidine) Accelerated Vulcanization. III. The Action of "Soluble Zinc Sulfide." Merton L. Studebaker and Lester G. Nabors.

The action of various compounding ingredients studied in the first two papers in this series suggests that hydrogen sulfide in some form is important in the development of polysulfide crosslinks, during DPG-accelerated vulcanization of natural rubber. This led to experiments on the elusive material called "soluble zinc sulfide." In this paper some of these experiments are described, and the results are combined with those of Bedford, Craig, Moore,

and others to give added insight into the mechanism of DPG-accelerated vulcanization.

4:05 p.m.—30. The Distribution of Rubber Literature. John McGavack, Leonia, N. J.

The references in the rubber bibliographies for the years 1941-1959 have been tabulated to review the growth of rubber literature and to determine whether the United States is maintaining leadership in this field.

The volume of rubber literature has undergone a 262% increase during the period 1941-1959. For the period 1951-1958, the increase plots as a straight-line growth curve of 13.5%. A sharp increase of 26% occurred in 1959 over the 1958 references.

The largest growth rate of 680% for 1941-1959 appears in the subject of rubber-like plastics. For the same period, references to synthetic rubber increased 278%. Other growth leaders included the subjects of chemistry and physics of rubber, vulcanization, antioxidants, adhesives, and tires. Decreases in references were found in the subjects of rubber derivatives and reclaim.

The United States has led in the number of references published in practically all categories, with strong competition in recent years coming from the Russian publications.

4:25 p.m—31. The South, Fastest Growing Rubber Area. D. A. Reneau, E. W. Howard, United Carbon Co., New York.

This talk presents the past growth and future prospects of the rubber industry in the South, with main emphasis on a recap of the tire and tread rubber industry. A history of 25 years of tire production and 20 years of tread rubber production is given. Information on personnel is included. In addition, statistical data on production by allied industries, such as SBR, carbon black, masterbatch, petroleum, and fabrics, are also presented.

4:45 p.m.—32. Evaluation of Antiozonants Via Stress Relaxation. G. E. Decker, R. W. Wise, Monsanto Chemical Co., Organic Division, Nitro, W. Va.

One of the most frequently used methods for appraising the extent of ozone cracking in rubber vulcanizates is visual examination. The subjective nature of the visual method leaves much to be desired, and considerable effort has been spent developing an objective evaluation procedure. A method based upon stress relaxation of a small rubber specimen during exposure to ozone has been developed. Accelerated and outdoor exposure results, both static and dynamic, are presented on a variety of N,N′-disubstituted-p-phenylenediamines. These data show the method to be discriminating, reproducible, and extremely rapid.

An ozone cabinet was constructed for accelerated testing in which it is possible to maintain the ozone concentration to within ±5 at 25 parts per hundred million. A unique apparatus was developed for the simultaneous flexing of 72 small specimens.

Friday Morning—
September 8
T. C. Argue, Presiding

9:00 a.m.—33. Gas Chromatographic Analysis of Antidegradants. R. W. Wise and A. B. Sullivan, Monsanto Organic Division.

Analytical methods which are rapid, precise, and specific have long been needed for the quantitative analysis of rubber antioxidants. Gas chromatography offers a new tool to the rubber chemist for the analysis of antioxidants which overcomes many of the problems associated with the use of the more classical techniques.

Rapid and precise gas chromatographic methods for the quantitative analysis of a wide variety of rubber antidegradants have been developed. The methods have also been used to identify and determine the amounts of antidegradants in rubber vulcanizates. Typical of the rubber chemicals which have been successfully analyzed by these techniques are N-isopropyl-N′-phenyl-*p*-phenylenediamine, N, N′-diphenyl-*p*-phenylenediamine, phenyl-β-naphthylamine, etc. Experimental details, typical chromatograms, and analyses of some of the more common antidegradants are presented.

9:15 a.m.—34. Adsorption Chromatographic Analysis of Petroleum Oils. T. B. Smitherman, Texaco, Inc., Port Arthur, Tex.

This paper describes the chromatographic separation of class constituents in rubber processing-type oils. A solution of the oil is passed through a column of adsorptive silica gel and washed successively with normal heptane, benzene, and pyridine. The constituents removed by these selective solvents are classed as non-aromatics, aromatics, and polar compounds, respectively. Data are presented to indicate the method precision and superiority over earlier methods.

9:35 a.m.—35. Laboratory Method for Testing Rubber Release Agents. G. P. Yates and P. E. Oppliger, Dow Corning Corp., Midland, Mich.

The purpose of this work was to devise a test method capable of screening potential silicone release agents. To industrial users of release agents this method is valuable because (a) it is faster and more economical than production evaluations, and (b) it detects differences not immediately recognizable on production equipment.

Laboratory test results have been confirmed by previous production evaluation programs. Also, theories with regard to the performance of silicone-type release agents have been substantiated. The majority of these tests has involved comparisons of silicone release agents significantly different in their chemical composition and physical properties. Tests were also made in which silicones were compared to non-silicone materials.

To industrial users of release agents who are interested in securing the most efficient and economical agent, this test provides a practical method for screening potential materials. Economies can also be effected since (a) the test method requires a minimum amount of inexpensive material and eliminates the risk of ruining production pieces, and (b) the test can rapidly evaluate, and give graphical analysis of, numerous release agents.

10:00 a.m.—36. Factors Controlling the Thickening of a Carboxylated Latex by a Polyacrylate Thickener. W. W. White, Naugatuck Chemical.

The effects of polymerization variables (emulsifier, potassium persulfate, and alkaline electrolyte concentrations) on the thickening of carboxylated styrene butadiene latices by polyacrylate thickeners were determined, using statistically designed experiments. Adequate thickening of latices is important in many applications.

The functional relation between the controlled variables and the properties such as particle size and surface tension of the final latices were determined, as was the relation between the thickening of the latex and the latex composition including polymer particle surface area. Increases in alkaline electrolyte gave an inordinately large increase in particle size of the latices, compared with non-carboxylated latices. Increases in emulsifier reduced, while increases in potassium persulfate increased, the particle size, but these effects were relatively small.

The surface area (inversely proportional to particle size) of the contained polymer particles was the dominant factor in thickening—the viscosity increasing with increased surface area. The thickener efficiency was decreased by each of the controlled variables although the emulsifier effect was much less than expected. Tests performed on latices before and after dialysis confirmed the electrolyte and emulsifier effects.

The alkaline electrolyte effects were associated with control of the manner in which the acid monomer polymerized and the consequent nature of the polymer surface.

Regression equations demonstrating the relation between the controlled variables and thickening efficiency will be presented.

10:25 a.m.—37. A Rugged Semi-Automatic Extensometer for Measuring Elongation of Rubber. Paul I. Donnelly, Hercules research center, Wilmington.

The evaluation of an elastomer—new or established—inevitably involves a study of tensile properties. ASTM procedure D 412 is generally used as a guide for the tensile testing of vulcanized rubber. In this method an operator observes bench marks on the sample and records the modulus at every 100% elongation, the ultimate elongation, and the tensile strength at break.

An extensometer has been developed to eliminate operator coordination and judgment factors from rubber tensile testing. This device is simple and sufficiently rugged for routine testing. Its features are a counterbalanced guide rod with a sliding electrical contactor, and specimen followers which automatically unlatch to avoid being damaged when specimens break. In addition there is a counter for direct digital indication of elongation, and an electrical circuit which controls a short duration spark to mark the autographic chart.

Experience in testing up to 5,000 specimens per year has shown that the apparatus makes an inexperienced operator as effective as a trained operator working under optimum conditions. The instrument has been used successfully on materials ranging from soft rubber to plasticized and filled poly(vinyl chloride).

10:40 a.m.—38. Physical Test Methods for Critical Evaluation of High-Performance Elastomers. C. F. Blaich and T. M. Vial, rubber chemicals department, American Cyanamid Co., Bound Brook, N. J.

The development of new high-strength elastomers in our laboratories required an examination of available physical testing methods for critical evaluation of experimental modifications. With these high-performance materials, conventional test procedures were found to be insufficiently definitive or too time-consuming.

The Die C tear test (ASTM D560) fell short, yielding similar readings for elastomers varying in hardness from 70 to 95 Shore A, in ultimate tensile from 4500-7500 psi., and in elongation from 450-825%. The split tear test is more useful within a narrow hardness range, but not for elastomers of varying hardness, probably owing to a stress distribution factor in the softer materials. A modification of the trapezoid tear test (ASTM D 751) was found to yield more significant values.

Similar difficulties are observed with conventional tensile testing, as usually reported. Many high-strength elastomers yield similar 300% modulus, ultimate tensile, and elongation values. Comparison of the entire stress-strain curve, especially at low elongations, gives better discrimination. Modification of the standard tensile test using ring and T-50 specimens was found to yield excellent comparative values, as well as conserve time.

Compression set determinations (ASTM D 395, Methods A and B) were modified to obtain more meaningful comparative data in less time.

Discussion and details of the methods and data are presented comparing the new elastomers with several commercial materials.

11:00 a.m.—39. An Electron Microscopic Reinforcement Criteria for Carbon Black Masterbatches. Eddie B. Prestridge, Copolymer Rubber & Chemical Corp., Baton Rouge, La.

The adequate dispersion of carbon black in rubber has long been recognized as an important factor in obtaining good physical properties in black rubber masterbatches. With the advent of wet masterbatching methods, which provide a preliminary dispersion of carbon black in latex, present techniques for the microscopic evaluation of the quality of this incorporation proved inadequate. An electron microscopic study was made to establish and define terms relating to the reinforcement of rubber stocks by carbon black at levels below the limits of resolution of the light microscope.

Using replica electron microscopy, examination was made of the dispersion and the physical habit of black particles in the fractured surfaces of black masterbatches. It was found that three terms were needed to correlate the quality of the black incorporation with the physical properties of the masterbatch. These are, in order of increasing effect on vulcanizate properties: dispersion, grinding, and bonding. The relation of these reinforcement criteria and the raw Mooney of the masterbatch reveals the striking effect of improved carbon black incorporation on this property and allows the possibility of evaluation of masterbatch production on a continuous basis.

By the determination of the reinforcement criteria, the performance characteristics of a tread stock made with such masterbatches can be predicted with good reliability.

11:20 a.m.—40. N, 4-Dinitroso-N-Methylaniline as a Promoter for *Hevea* and SBR. L. A. Walker and J. E. Kerwood, Monsanto organic division.

The great improvements in modulus, heat build-up, and dynamic properties in general which have been realized in butyl rubber tire formulations by the use of N, 4-dinitroso-n-methylaniline have, for some time, been attributed to increased reinforcement and/or increased elastomer-carbon black interaction promoted by the chemical. With the belief that improved reinforcement brought about by this chemical could be applied to elastomers other than butyl, the investigation was expanded to include *Hevea*, SBR, and blends of the two elastomers.

The use of standard laboratory evaluations (stress-strain, Goodrich flexometer, DeMattia Flex, hot tear strength) has been supplemented with torsional hysteresis, dynamic modulus, internal friction, and bound rubber measurements to show significant improvements in reinforcement. Laboratory tests have shown that, by the use of N,4-dinitroso-n-methylaniline, up to 50% of *Hevea* in tread formulations can be replaced by SBR with the resultant heat build-up and/or hysteresis properties being equal to or better than those of *Hevea* alone. Decreased amounts of curing agents in the promoted stock retain excellent hysteresis properties, improve flex life, and hold the modulus relatively unchanged.

Firestone Wins Award

Pioneers in the development of giant earth-moving equipment which has made today's complex transportation system possible will receive the Elmer A. Sperry Award for 1961. The award, administered by a board composed of representatives of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society of Naval Architects & Marine Engineers, Society of Automotive Engineers, and Institute of Aerospace Sciences, is presented for "distinguished engineering contribution which through application, proved in actual service, has advanced the art of transportation whether by land, sea or air."

Recipients this year will be Robert G. LeTourneau, known as the "father" of giant earth-moving machines, and the research and development division of the Firestone Tire & Rubber Co. According to the announcement made by Robert B. Lea, on behalf of the Elmer A. Sperry Board of Award:

"The Elmer A. Sperry Award for the year 1961 is made jointly to R. G. LeTourneau in recognition of his development of large-capacity, high-speed, automatic, earth-moving equipment, and to the research and development division of the Firestone Tire & Rubber Co. in recognition of its pioneering the giant-size, heavy-duty tires which made such equipment feasible."

Developments pioneered by Firestone are credited with freeing earth-moving equipment from the metal wheels which once limited their effectiveness.

The award will be officially presented on September 12, at an SAE meeting in Milwaukee, Wis.

Wins RW Award

Grant Carpenter, of Goodyear's Los Angeles plant, has won the RUBBER WORLD Award for 1960-61, granted to a student at the Tlargi Rubber Technology Foundation. Full details will be published in our next issue.

Rubber Division, CIC, Schedules Technical Meeting in Montreal

The annual conference of the Chemical Institute of Canada, Division of Rubber Chemistry, will be held on Friday, August 4, in the Queen Elizabeth Hotel, Montreal, P.Q., Canada. This meeting will be in conjunction with the three-day meeting of the parent CIC. In addition, the following week will see the eighteenth International Congress of Pure and Applied Chemistry being held also in Montreal.

The Rubber Division's morning technical session will include several papers on the latest aspect of rubber technology, and the afternoon session will be devoted to textiles as related to the rubber industry.

The full program for the day is as follows:

Program and Abstracts of Papers
Friday, August 4

9:00 a.m. Coffee party, compliments of the Rubber Division; an excellent time for renewal of friendships.

Morning Technical Session
Chairman: D. G. Seymour, Chairman of Ontario Rubber Group

9:30 a.m. Progress in Pneumatic Tire Vulcanization. G. D. Stevens, Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont.

The subject of tire vulcanization would not be complete without a review of the progress made not only in types of equipment used for vulcanization, but also the procedures. During the evolution of more efficient methods for tire vulcanization the time required per unit has been reduced in the past 30 years for a popular passenger size from 105 minutes to less than 18 minutes; while the tire size cross-section has increased from 4.75 to 7.50 inches.

This improvement in tire vulcanizing efficiency has been made possible as a result of improvement in vulcanizing equipment; materials and methods used for tire mold construction; gage reductions; and better heat conductivity of pressure container used for tire forming molding and vulcanizing, as well as improvements in compounding materials and carcass cord members in the tire proper.

High temperature and short-time cycle tire vulcanization is essential to obtain maximum efficiency with minimum capital expenditure to meet the continually expanding range of sizes and types of tires required in today's market. At the same time, with shortened vulcanizing cycles, greater accuracy and reliability of control equipment are required to use safely the most efficient procedures.

10:00 a.m. Improving the Ozone Resistance of Nitrile Rubber. W. J. Abrams, Polymer Corp., Ltd., Sarnia, Ont.

Although copolymers of butadiene and acrylonitrile are widely accepted as oil-resistant rubbers, their lack of ozone resistance has limited their usefulness in certain fields. It has been shown that these polymers can be made ozone resistant without detracting from their oil resistance by blending them with poly(vinyl chloride). Attempts have been made to define the nature of the microchanges in the surface of nitrile rubber/poly(vinyl chloride) specimens following ozone attack.

The choice of poly(vinyl chloride) resin and nitrile rubber and the effects of varying the ratio of rubber to resin on the ultimate properties of the blend are recorded. Typical properties are shown for different methods of blending the rubber and resin. Compounding of nitrile rubber/poly(vinyl chloride) resin blends is reviewed, and some recent applications are summarized.

10:30 a.m. *Cis*-Polybutadiene. E. W. Madge, research manager, Dunlop Research Center, England.

Cis-polybutadiene is an elastomer of considerable technical and commercial interest. Its behavior in a wide range of circumstances has received much attention, and many unusual properties have been disclosed. Some of these should have been predictable; others could not have been. Unusual features associated with carbon black interaction, wear resistance, electrical, rheological and strength properties, etc., are discussed. Some of the basic reasons for the results obtained are obscure; others are examined in the paper.

11:00 a.m. Lignin as a Reinforcement for SBR in Military Pattern Tires. T. R. Griffith, National Research Council, Ottawa, Ont.; D. W. MacGregor, formerly of Howard Smith Paper Mills, Cornwall, Ont.; and Lloyd Krichew, Army Development Establishment, Ottawa.

This paper deals with recent findings resulting from continuing studies being conducted on lignin in military tire compounds via the Army's cooperative program with other government agencies and Canadian industry.

Previous papers on SBR-lignin, presented in 1957 and 1958, reported on the indoor and outdoor performance of 11.00x20, 12 PR military tires having a SBR-lignin tread, with a conventional carbon black carcass construction; lignin-rubber theory and practices also were indicated to demonstrate compound choice.

The progress made in the compounding design of tread and carcass stocks will be presented, illustrating the effect of lignin loading on physical properties, acceleration system effect on processing, and the consequent performance of large-diameter nylon-cord lignin construction tires. These tires were produced using lignin carcass and tread compounds with characteristics that have made possible reduction of crude rubber content from 40 to 10%.

11:30 a.m. Business Meeting.

12:30 p.m. Rubber Division Luncheon. Speaker: M. F. Anderson, president, Dominion Rubber Co., Ltd. Topic: "Modern Trends in the Rubber Industry."

Afternoon Technical Session
Chairman: J. J. M. Campbell, Chairman of Quebec Rubber & Plastics Group

The afternoon session consists of four speakers on Textiles as Applied to the Rubber Industry.

2:00 p.m. Nylon Yarns and Fabrics in Industrial Applications. A. R. Szewczyk, Du Pont of Canada, Ltd.

Nylon applications to industrial products are discussed, with particular reference to the properties of nylon yarns and fabrics which result in better-performing industrial products. Some of the applications to be discussed are tires, conveyor belts, ropes, fish nets, and products utilizing coated fabrics.

2:30 p.m. Cotton. D. James, Cosmos Imperial Mills, Ltd.
(No abstract available.)

3:00 p.m. Terylene. John Little, Canadian Industries, Ltd.
(No abstract available.)

3:30 p.m. Textiles in the Rubber Industry—Rayon. Mark Abbott, industrial marketing manager, Courtaulds Canada, Ltd.

The properties desirable in fibers for industrial textiles, as distinct from apparel and household uses, will be reviewed and related to the properties of present-day rayon yarns.

The industrial market for fiber is dominated by tire fabric, which consumes approximately 30% of the total market. In Canada, rayon has been the major tire fabric since 1949. The improvements in rayon tire yarn to the present day and the improvements in tires these developments have permitted will be discussed.

Other major industrial uses are conveyor and transmission belts and hose. Rayon is gaining a wider acceptance in these fields, and these will be covered in some detail. In addition, some discussion will be presented of further developments into new industrial uses aimed to extend the total market for industrial fiber.

Some New Frontiers of Rubber Outlined

"New Frontiers of Rubber" were discussed at the spring meeting of the Connecticut Rubber Group held at the Waverly Inn, Cheshire, Conn., May 19. A large audience was on hand to hear the panel present some of the latest information on elastomers used in construction, the story of the nylon/rayon tire, and elastomers in rocket motors. The after-dinner speaker, Earle S. Ebers, group vice president, United States Rubber Co., gave a general lecture on the subject of the meeting, "New Frontiers of Rubber."

The use of elastomers as materials for construction was covered by J. S. Jorzcyk, vice president, Thiokol Chemical Co., in his talk, "Elastomers As Materials of Construction." He traced some of the history of the discovery of the polysulfide rubbers, the small start in producing them, and the few limited uses developed in the early days. From this modest beginning, the speaker explained the steps which were first just visions and then became realities in the progress of the Thiokol rubbers in sealants and cements. As more and more materials were considered for use in buildings and the concept of curtain walls became practical, the use of these rubbers for sealing building units was found to be necessary to solve problems of leakage, vibration, and expansion and contraction.

Jorzcyk also covered briefly the use of Thiokols in rocket fuels and went into some newer areas of construction such as roadways and the repair of concrete structures. A tie cement based on polysulfide liquid polymers as flexibilizing copolymers with epoxy resins is being used to bond fresh concrete to old, to seal against penetration of water and salt solutions, and as coatings to seal the surface and hold non-skid grit for a safer roadway. This speaker envisions many more applications of this type to improve service of such pavements and structures and to permit repairs to be made more quickly.

A. L. McMullen, vice president, Seiberling Rubber Co., told the Group about his company's new nylon/rayon combination cord tire being marketed under the trade name, "Nytex." He remarked that tests being run continue to bear out the advantages and claims made when this construction was introduced publicly a few months earlier. (See RUBBER WORLD, April, 1961, page 81: "New Tire Construction Joins Nylon and Rayon.")

Marion Gold, manager, propellent chemicals, Aerojet-General division of The General Tire & Rubber Co., gave those present a rundown on the current status of the use of "Elastomers in Rocket Motors." His talk, cleared for verbal presentation, but classified for publication, included some of the work done to date and indicated what many of the needs were for the future. He suggested that many new elastomers would be needed and would be developed to solve the problems relating to the peculiar properties desired in rocket fuels.

After dinner Dr. Ebers told the assembly that much more must be done to accelerate current developments in the elastomer field. He noted that current research work would provide the new elastomers needed in the future and that not enough basic research was being done in this field to keep abreast of technological progress in other fields. He suggested that much more could be done to stimulate this basic work in universities and industry laboratories. Adequate funds must be provided, and the research people must be given sufficient recognition within the organization without taking them out of research into administration or other areas of company activity.

Karl W. Brandau, Firestone Tire & Rubber Co., was moderator for the afternoon panel session and handled the questions period which, unfortunately, had to be curtailed owing to lack of time.

Groups Enjoy Outings

New York Group

Approximately 250 persons attended the annual outing of the New York Rubber Group, held June 1 at Old Cider Mill Grove, Union, N. J.

A. M. Gessler, Esso Research & Engineering Co., was outing chairman, and Jack Callan, Columbian Carbon Co., was cochairman. Chairmen of the athletic events were: Jim Fusco, Enjay Chemical Co., softball; Bill Lamela, Okonite Wire & Cable Co., quoits; Glenn Vickery, General Tire & Rubber Co., bocci; Dick Glidden, Ames Rubber Corp., basketball; Bob Lukacik, Pennsalt Chemical Co., fly casting; Jack Briggs, Esso Research, ball pitch; A. H. Woodward, E. I. du Pont de Nemours & Co., Inc., golf pitch; Stan Shuart, Enjay, dart throwing; Ralph Ambrose, Rodic Rubber Co., hit-the-bottle; and William Hartman, Laurie Rubber Reclaiming Co., egg throwing.

The person with the highest point total in all events was Arthur Donofrio, Toscony, Inc., who won a $100 bond. John Schon, Jr., John Schon Tool & Machine Co., second prize winner, won a $50 bond. R. M. Kearsley, Thompson Weiman & Co., won a $25 bond for third prize.

First and second prize winners for the individual events, in order of finish, were: *quoits*, Bill Lamela; George Ziarnik, Esso Research; *bocci*, Jack Callan and P. Melore, both of Columbian Carbon; K. E. Chester, C. P. Hall Co., and H. H. Watjen, Interchemical Corp.; *baseball throw*, John Schon, Jr., and Jim Fusco; *basketball throw*; Edward M. Berberian, Columbian Carbon; John Branci, Cooke Color Co.; *fly casting*, John A. Stipak, Columbian Carbon; C. C. Sheets, Jr.; *golf pitch*, R. Hunt; W. B. Curtis, Naugatuck Chemical Division, United States Rubber Co.; *darts*, R. M. Kearsley; Harry J. Emore, Phillips Chemical Co.; *hit-the-bottle*, M. J. McDonald, Allied Chemical Corp.; A. M. Gessler; *egg throw*, Arthur Donofrio and J. Libre, both of Toscony.

Some of the principals of the Connecticut Rubber Group meeting on "New Frontiers of Rubber" were: *left to right*, K. W. Brandau, E. S. Ebers, A. L. McMullen, M. Gold, and F. B. Smith, Group chairman

Spectator at the dart throw can't believe it, but it's a bull's eye. Looking on at the New York Rubber Group's annual outing are, *left to right*, George Ziarnik, E. H. Herron, Esso Research; R. J. Onufer, Enjay Chemical Co., and Herb Simons

Members of the winning softball team were: Richard R. Stimets, United Carbon Co.; Ronald M. Mineo, Enjay; Robert E. Clayton, Esso Research; Roger J. Daly, Columbian Carbon; George Smolka, Pantasote Co.; Arthur Donofrio; Bruce A. Thorsberg, Dow Corning Corp.; Eli A. Robinson, Collette Mfg. Co.; John Schon, Jr.; and Werner C. Schon, Schon Tool & Machine.

Boston Group

The twenty-fifth annual outing of the Boston Rubber Group was held June 16 at the Andover Country Club, Andover, Mass. Nearly 650 members and guests were present to enjoy a perfect day for golf, baseball, horseshoes, and just plain fun. Dinner was served under the Big Top and included the customary famous lobsters and salad courses.

Prizes were given out following the dinner. The United Carbon Trophy, a large Paul Revere Bowl, awarded for the first time, was won by J. Burns (Shell Oil Co.). He also won a "shillalah" golf club. The United Carbon Trophy will be engraved with each year's winner and will be retired by the first person to win it three times. United Carbon employes are exluded from this competition; consequently D. Stimets, actual winner, was forced to take second place.

The committee, headed by Robert Loveland (R. T. Vanderbilt), included Chester A. Stoeckel (Firestone) and Harry Atwater (Malrex Chemical), as directors, and William Platt (Pittsburgh Plate Glass), E. F. Freeman (Stedfast Rubber Co.), Tom Weaver (Columbian Carbon), John Ledden (Du Pont) N. Herthel (Goodrich Footwear), Charles Sprague (Sierra Talc), and James Cyphers (Boston Woven Hose).

Winners in the various activities of the day follow: 18-hole tournament: low gross—J. Burns, D. Stimets; low net—H. Collyer (Cabot), R. Babbitt (Vanderbilt); kicker's handicap—Lyle Longworth (Monsanto), C. Parisi (Colab Resins); nearest to pin—Bo Adamson (Goodrich-Gulf), James Breen (Barrett & Breen); high gross—R. Wade (Quabaug); high net—G. Bushway (Tyer); long drive—Arthur Patrick (Dewey & Almy). Nine-hole tournament: low gross—J. Lunderville (American Sisalcraft), A. A. Macalaster (Macalaster-Bicknell); low net—G. Hodgson (A. D. Little); Donald Marsh (Neville); kicker's handicap—C. Harvey (Synthon, Inc.); high gross—Alan Lukens (Lukens Chemical); high net—R. Murphy (Synthon); darts—Joe Coscia (Raffi & Swanson), R. Eaton (Sun); tub and ball—Harrison Doyle (Summit Chemical), Ray Hofferbert (Pellon); putting—C. Parisi, Harold Dietrich (General Magnesite); horseshoes—Edward Hogan and Donald May (Goodrich Footwear), David MacIntosh and Howard Gavin (Armstrong Cork); baseball—Cabot Corp. team, 4 to 3, over a pickup team.

The next meeting of the Boston Rubber Group will be on October 13, at the Hotel Somerset, Boston, Mass., speaker and subject to be announced.

Rhode Island Rubber Club

The Rhode Island Rubber Club held its very successful annual summer outing at the Pawtucket Country Club, Pawtucket, R. I., June 8, with more than 250 members and guests attending. The main event of the outing was the 18-hole golf tournament. The better golfers were awarded prizes based on their gross scores. Dick Stimets (United Carbon) was again low man, followed closely by George Malo (Heyman Blade), Fritz Malcom (Titanium Pigment), Lyle Longworth (Monsanto), and P. A. Uva (Avon Sole).

For the other golfers a contest was run using the Calloway system of scoring. Low net was taken by W. Stone (Kleistone Rubber); second, Robert Van Amburgh (Davol Rubber); third, C. K. Mullin (C. K. Mullin, Inc.).

Clem Damicone (Acushnet Process) uncorked the longest drive of the day on the 18th hole. Jack Ryan (Archer Rubber) was rewarded for being the most honest golfer of the Club. When the final scores were tallied, it was found that Jack had taken and counted more strokes than anyone else.

E. L. "Doc" Hanna, retired technical manager of Davol Rubber Co. and a charter member and former chairman of the Rhode Island Rubber Club, was the honored guest of the day.

The success of the outing was due to the hard work of the chairmen, Clem Damicone, Joseph Donahue (Goodyear Tire & Rubber), Paul Hastings (Kleistone Rubber), Joseph Vitale (Crescent Co.), and their assistants, Vincent Casey (J. M. Huber Corp.), Tom Crosby (H. Muehlstein & Co.), and Ed Uhlig (U. S. Rubber).

Buffalo Golf Tourney

The Buffalo Rubber Group golf outing was held on June 13 at the Lancaster Country Club.

Dinner was served to the 135 guests

(*Continued on page 114*)

Some of the people who helped organize the Boston Group outing (*left to right*): Jim Cyphers, Harry Atwater, Tom Weaver, George Hunt (Simplex Wire & Cable), Bob Loveland, George Smith (Du Pont), George Herbert (Tyer), Ted Freeman, and N. Herthel

washington report

By JOHN F. KING

Rubber Industry Joins In Attacks On Administration's Tax Proposals

The Senate and the House were bargaining in late June over a compromise highway financing program that has held the interest of the rubber industry ever since the legislation began its tortuous path through Congress early this year.

Meantime, another tax bill being closely watched by the industry—President Kennedy's loophole-tightening measure which would crack down on expense account abuses and unwarranted tax privileges accorded foreign investment—ran into opposition from rubber manufacturers. Along with complaints from a score of other industries, their criticism has stalled the plan in the House Ways and Means Committee. It is almost a certainty there will be no action on it this year because of the opposition it has stirred.

In the highway financing program, the Senate approved a series of tax increases on tires, tubes, and tread rubber, June 15. Like the House, the upper chamber boosted the 8¢-per-pound tax on tires and tubes to 10¢, but it allowed only another penny a pound increase to 4¢-per-pound, in the tax on tread rubber. The House approved a 5¢ tread rubber tax; while the Administration requested a 10¢ levy.

The only other difference between House and Senate versions which must be ironed out in conference is the Senate's decision to delay transferring a portion of the truck and bus excise tax from the General Fund to the Highway Trust Fund, until 1962. The House would make the transfer effective July 1 this year. The Senate bill also provides an allowance of 1% to retailers for tax paid on gasoline lost by shrinkage and evaporation, a provision not in the House bill.

Government Control Hit

The Rubber Manufacturers Association, Inc., after surveying the Kennedy general tax program now pending in the Ways and Means Committee, came down hard on the system of "rewards" and "penalties" which it said comprises the plan. If adopted, RMA claims, direction and control of the economy would be hinged on "a preconceived set of government standards."

While the rubber industry agrees that there is a pressing need of tax reform to stimulate greater capital formation and more rapid economic growth, RMA said,

"We are alarmed over this tendency toward more federal regulation, control, and direction over the decisions of the individual and corporate citizens of a free society."

As a practical matter, RMA pointed out that the Treasury currently is charting a long-range overhaul of the tax structure and that the pending legislation should be delayed until that review is finished.

"Most of the changes now requested are for years beginning after December 31, 1961, and in one instance would not be effective until 1963."

Specifically, the Rubber Manufacturers Association singled these Kennedy measures out for criticism:

(1) The proposal to repeal the dividend credit would be a "backward step" in that it reestablishes the inequities of double taxation.

(2) The investment tax credit plan, whereby a company would be able to claim a portion of new plant and equipment investment as credit against normal taxes, is an "unwanted subsidy" for United States industry. If the Administration really wants to boost industrial investment, it should liberalize depreciation allowances, RMA declared.

(3) The proposal to close expense account tax loopholes is an "arbitrary invasion of business management's decisions of what is 'ordinary and necessary' to the successful conduct of business.

(4) The proposal to force firms to pay U. S. taxes on their foreign earnings in developed countries, whether or not repatriated, will not increase U. S. tax revenues, improve the U. S. balance of payments position, foster domestic investment or spur investment in underdeveloped countries.

Challenge Foreign Earnings Tax

Individual rubber companies with far-flung international operations, such as Goodyear Tire & Rubber Co., presented their individual views on this last point.

For example, H. J. Heinz II, head of H. J. Heinz Co., speaking for 19 big firms including some in the rubber industry, challenged the Treasury's estimates that modification of the foreign income tax deferral privilege would increase revenue collections without adversely affecting U. S. business' incentive to invest abroad.

Heinz said the 19 firms he represented by themselves were directly responsible for nearly a quarter billion dollars worth of U. S. exports last year —through shipments by the parent company to its foreign subsidiaries. Noting that this effort was a net contribution to strengthening the U. S. payments position, he stated Treasury also failed to take into account the payments by these subsidiaries to the domestic parents for services as well as other "plus" payment items which he said explodes the theory that U. S. foreign investment is a burden on the U. S. payments and gold outflow situations.

Heinz, speaking for such firms as Goodyear, General Electric, Cabot Corp., Monsanto, Texas Butadiene & Chemical, Union Carbide, and others, succeeded in giving the Ways and Means Committee pause with the Kennedy program. Already hostile to the general Kennedy approach, the Committee for all intents and purposes has sidetracked the legislation this year. The only question is whether it will continue to sit on the bill next year too. Most observers considered this entirely possible.

Rubber Firms Work on Defense Research

Rubber industry research was prominent in the Kennedy Administration's acceleration of the defense program in late May and early June. Hot on the heels of the President's second State-of-the-Union message to Congress calling for several hundred million more for defense contracting and research, Aerojet-General Corp., a subsidiary of The General Tire & Rubber Co., was tapped by the Atomic Energy Commission and the National Aeronautics & Space Administration to develop, in partnership with Westinghouse Electric Corp., the first phase of an atomic-powered rocket engine designed to send a rocket to the moon.

A week previously the Navy had announced that it would give "full and unbiased consideration" to the development of a rubber "Inflatoplane" which has figured in a three-year dispute over operation "Wagmight." (See RW, May, 1960, page 103.)

In the meantime the Air Force launched its effort to develop more powerful solid missile fuels by awarding contracts worth more than $1.8 million to five firms in the rubber and allied industries. Directed to develop "a new family of solid propellants which will have even higher energy and performance characteristics than those presently used in the highly successful Air Force Minuteman and Navy Polaris missiles" were: Aerojet-General; Atlantic Research Corp., Alexandria, Va.; Du Pont's explosives department, Gibbstown, N. J.; Thiokol Chemical Corp.'s Elkton Division; and United Technology Corp., Sunnyvale, Calif.

Then, on May 19, Goodyear Aircraft Corp. presented its plan for an inflatable structure that could serve as a manned space station to the House Committee on Science and Astronautics. Goodyear said that by using presently known techniques and hardware, the United States could have a 30-foot donut-shaped structure carrying a man in orbit within three years.

Nuclear Rocket Planned

The most immediate and exciting news, however, was the Aerojet-Westinghouse contract to develop the power plant for Project Rover, the rocket the United States hopes will carry its astronauts to the moon. The contractor team will spend six months designing the engine and, working with the joint AEC-NASA office, will work out a long-range development program for the nuclear rocket. It is expected that the Aerojet-Westinghouse team, if successful in the design effort, would proceed with actual development of the engine, nicknamed Nerva (Nuclear Engine for Rocket Vehicle Application) at a cost of between $300-$400 million.

Under the AEC-NASA contract, which still has to be negotiated with Aerojet and Westinghouse, Aerojet would be responsible for most of the work. This will involve developing the engine system and integrating the nuclear reactor with the many non-nuclear components. AEC itself will do most of the basic research and development of the reactor; while Westinghouse will do the engineering and refinements on the reactor. The Aerojet-Westinghouse bid was accepted from a total of six proposals.

AEC Chairman Glenn Seaborg told the House Space Committee, June 7, that a nuclear rocket could be flight-tested by 1967 at the latest, with the vehicle being operational by 1970. He said the chief advantage of a nuclear rocket engine over the conventional liquid- and solid-fueled engines is that it would provide two to three times the amount of power for the same quantity of propellants.

The nuclear reactor, he added, would use solid uranium fuel elements. Liquid hydrogen propelled through the core of the reactor would be heated by nuclear reaction and, turning to gas, would expand suddenly and be forced out a nozzle at the rear of the rocket, thus providing the thrust.

President Eisenhower had asked $45 million for the Rover project. President Kennedy boosted this sum to $83 million, including $15 million to start actual construction of facilities needed for flight test.

To Consider "Inflatoplane"

The Navy's promise to give full consideration to the "Inflatoplane" came from Navy Secretary John Connally, May 26, after the dispute over the project between its developer, Capt. Cooper Bright, and the Navy's top research and development brass flared anew. The Connally statement, prompted by Bright's statement to the House Space Committee three days before that he had been ordered to destroy data on the vertical-takeoff inflatable rubber craft, did not, however, solve the Captain's personal problem. Even though the Navy Secretary said he would look at the project on its merits, Captain Bright would still be transferred to San Francisco as inspector of Navy materiel. Bright's difficulties arose from his attempt to publicize the "Inflatoplane," whose prototypes were developed by Goodyear Aircraft, and thereby get around the objections of senior officers. He claimed they frowned on the idea of building an armada of the craft for simultaneous launch, equipped with atomic weapons, because it threatened the future of aircraft carriers. The superiors, particularly R&D chief, Adm. John Hayward, argued it was just one of hundreds of project ideas and that, like these others, it should be developed through regular channels.

In promising to give full consideration to the "Inflatoplane," Connally directed Bright to provide the Navy Bureau of Weapons with complete data on the project. He then assigned Dr. James H. Wakelin, Assistant Secretary of the Navy for R&D, to monitor the program.

GSA Seeks Revision in Stockpile Sales Rules

The United States Government began tinkering again with the mechanics of its disposal program for stockpiled natural rubber. It was generally expected that before the summer is out, there will be some changes in disposal ground rules.

The need of changes in disposal policy is occasioned by the fact that disposal operations are falling badly behind schedule because of a drop in the market early this year, coupled with the rigidities of the current price formula for stockpile sales.

Under the plan adopted last year to dispose of some 470,000 short tons of stockpile natural rubber over the next eight years, the government bound itself not to sell at less than 30¢ a pound. When the market price was between 30-36¢ the government would sell limited amounts each quarter; when the price was above 36¢, it could sell practically without restriction.

This scheme worked well in its early months, but the decline in rubber prices early this year when, for a time the price dipped below 30¢, brought the program to a halt. The rise in the market this spring produced a resumption in disposal operations, but the government's best month produced sales of only about 2,500 short tons. Under the overall sell-off plan, the minimum target was 10,000-12,000 tons a quarter, or about 3,500 tons a month.

With sales falling behind schedule early in 1961, the General Services Administration decided the price formula had to be changed. It made various proposals to relax the ultra-cautious ground rules, but the Office of Civil & Defense Mobilization, along with the State Department, took the go-slow approach. While GSA has operating authority over stockpile management, OCDM makes the policy. Because international problems arise when stockpile sales depress world prices in key commodities such as rubber, the State Department has an effective veto over OCDM.

In mid-June, State Department officials said they were aware of the other agencies' interest in speeding up rubber sales, but pointed out rubber-producing nations had to be consulted first. Such consultations had not even begun, they added, underscoring the point that any changes will take time and will not

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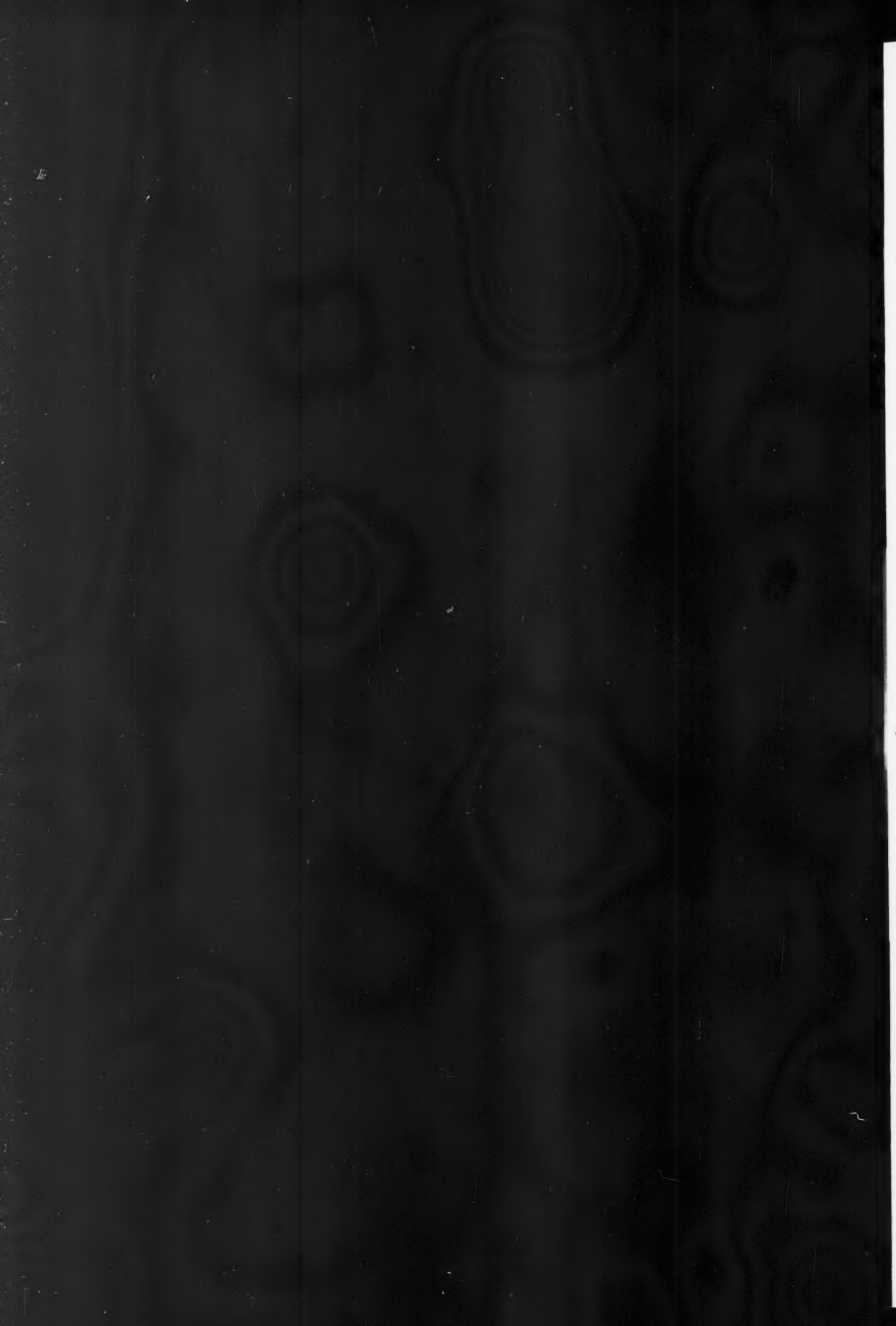

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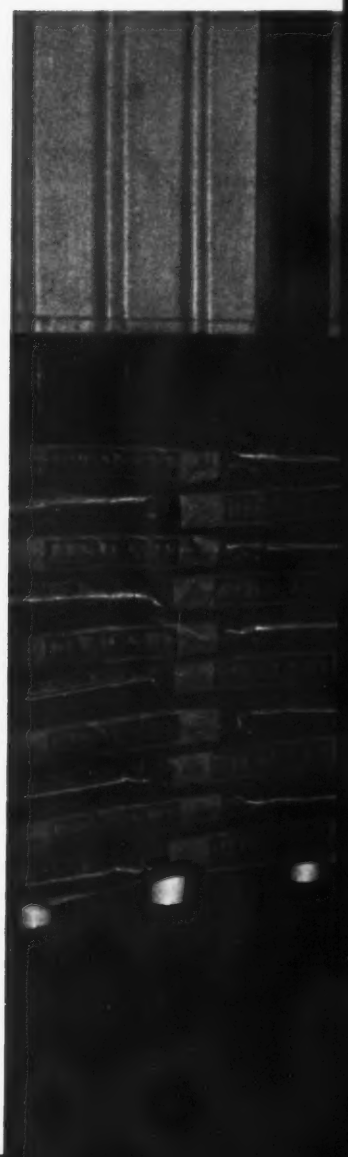

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Printed in U.S.A. July

be hastily conceived. Unless the rubber market rises appreciably this summer, thus permitting more sales under the current formula, pressure to change the system will become almost irresistible.

U. S. Firm-Soviet Bloc Contract Under Fire

The European Soviet bloc has been holding out tempting offers to United States firms if they will venture across the Iron Curtain to help the Communists build a petrochemical industry, including synthetic rubber plants. Many firms have been tempted to take the Soviets up, particularly when they see British and other European firms, including some in the rubber industry, cashing in heavily with Russian, Czech, and Rumanian contracts. But most U. S. firms have been wary, justifiably so, it turns out, when it is seen what happened to Hydrocarbon Research, Inc., New York, on June 15.

In 1959 this firm and its French and German affiliates, Hydrocarbon Engineering S.a.r.l., Paris, and Hydrocarbon Mineraloel, G.m.b.H., Duesseldorf, entered into a contract with the Rumanian Government to design and supervise construction of an oil-refining and petrochemical plant in the Communist satellite. When it entered into the contract, Hydrocarbon assured the U. S. Government that no U. S.-origin unpublished technical information would be used in the engineering of the project. Such material, the firm knew, required a validated export license which the U. S. Government would not grant. Before it entered into the contract, Hydrocarbon assured the government that no unpublished, hence unlicensable, data would be used.

Then, early this spring the Commerce Department, which supervises export controls, raised questions whether Hydrocarbon was using technical data lawfully exportable to the Rumanian project under open-end general license, or whether it had in fact violated the ban on use of unpublished material. Hydrocarbon itself denied that this had happened, but the government, which admitted it wasn't sure exactly what had happened, was not convinced.

". . . The nature of the investigation to date," Commerce said, June 15, "warrants close scrutiny of any and all of the Hydrocarbon group's prospective transactions with the Sino-Soviet bloc and Cuba."

Pending the outcome of the investigation, it said, the firm, its foreign affiliates, and all officers and agents thereof will have their collective export privileges lifted for 90 days. In the meantime the firm must provide full details of its transactions in the Rumanian project.

"Whether any charges will ultimately be placed against the Hydrocarbon group will depend upon the results of the . . . investigation into this complicated matter," the Department added.

Hydrocarbon, while denying any violation of export controls, agreed to the entry of the 90-day suspension "while the investigation continues."

Export control enforcement officials report that a permanent denial of export privileges, a penalty meted out quite regularly for violations, often is sufficient to put a firm completely out of business.

FDA OKs Food Wraps

The Food & Drug Administration early in June put its final stamp of approval on the use of polyethylene, both conventional and high density, for applications that call for usage of film, polyethylene coated paperboard, and injection-molded containers in food packaging. The action was coupled with a clean bill of health from FDA for ethylene-butene-1 copolymer also used in the food packaging, processing, and preparing industries.

FDA's rulings on the two materials, which are of growing importance in the food packaging industry, were made in the June 10 *Federal Register*, which includes the various tolerances and other prescribed conditions under which the two items may be used with food.

U. S. Rubber Workers Get Wage Increase

United States Rubber Co. and the United Rubber, Cork, Linoleum & Plastics Workers, AFL-CIO, reached agreement on a new two-year master contract and wage pact covering 25,000 workers.

The wage agreement calls for a 7½¢-an-hour increase, effective June 5, for employes of the company's five tire manufacturing plants, in Chicopee Falls, Mass., Detroit, Mich., Indianapolis, Ind., Eau Claire, Wis., and Los Angeles, Calif. The employes will receive another 7¢-an-hour raise on June 11, 1962.

Employes of 12 plants manufacturing such widely diversified products as golf balls, footwear, vinyl resins, chemicals, and mechanical rubber goods, received a wage increase of 3½¢ an hour, effective June 5, and 4¢ an hour effective, June 11, 1962. These plants are located in Naugatuck, Conn., Woonsocket and Providence, R. I., Mishawaka, Ind., Philadelphia, Pa., Santa Ana, Calif., Chicago, Ill., North Bergen and Passaic, N. J., and Painesville, Ohio.

The master contract signed by the union and the company calls for improved supplemental unemployment benefits, an additional paid holiday, and special provisions for job protection and grievance procedures.

Goodrich-URW Sign

The B. F. Goodrich Co. and the United Rubber Workers Union signed a new two-year contract giving 11,500 BFG employes in eight plants essentially the same wage increases (14½¢ per hour maximum over the next two years), unemployment benefits, holiday and other fringe benefits which URW negotiated with the other three companies of the Big Four earlier this year. The agreement was reached June 11 following lengthy negotiations in Columbus, O.

NLRB Orders Election At Aerojet-General

The National Labor Relations Board on June 13 directed that an election be be held at Aerojet-General's Downey, Calif., plant within a month to determine if the Engineers & Architects Association is to be the union bargaining representative for all Aerojet employes engaged in tool design, fabrication, planning, and quality control.

The Association, which petitioned NLRB for the election, proposes alternatively to have a jurisdiction election among all technical employes in Aerojet's manufacturing division. The company argued against any representation election because none of the employe units sought to be organized by the petitioning union includes all technical employes at the Downey plant

Voting to decide whether the Association is to represent them as collective bargaining agent, NLRB said, shall be "all technical employes . . . including technical employes in departments 1052 and 1062, but excluding all other employes, guards, professional employes and supervisors. . . ."

Floor Stocks Tax

The Internal Revenue Service of the United States Treasury issued a technical information release, TIR-322, on June 28 noting the floor stocks taxes of 2¢ a pound on tires of the type used on highway vehicles, 1¢ a pound on inner tubes for any type of tire except inner tubes for bicycle tires, and 2¢ a pound on tread rubber. The floor stocks tax, a part of the federal-aid highway act, was imposed July 1.

Silicone Rubbers Play Major Role In Expanding U. S. Missile Program

The half-inch-thick sample of silicone rubber shown was exposed to temperatures of 9,000° F. in tests at the G-E missile and space vehicle department. The hard, carbonaceous crust protected the undamaged rubber from the heat

Silicone rubbers, along with silicone resins and fluids, are playing a major role in the United States space program, General Electric Co.'s silicone products department reports.

General Electric researchers, speaking at a press conference in New York, reported that hundreds of pounds of silicones are used in some of the newer U. S. missiles.

One of the most important developments in the missile field, they said, is the finding that silicone rubber can withstand temperatures of up to 9,000° F. for up to six minutes; under the same conditions a steel plate was burned through.

They also reported that the extreme temperatures formed a hard, carbonaceous crust on the surface of the samples, leaving the remaining 70% of the material flexible and undamaged. The undamaged rear portion of the samples reached a temperature of only 450° F. after six minutes' exposure to the 9000° F. surface temperature.

Exterior Insulation

One of the principal missile applications for silicones is as an insulator on parts of missile exteriors to protect the surfaces from the extreme heat of blast-off and reentry. Silicone rubber is normally considered useful only up to temperatures of 600° F. Findings, G-E researchers indicated, may lead to possible development of silicone rubber uses for nose cones, which develop the highest temperatures.

The tests were conducted at the company's missile and space vehicle department in Philadelphia, in an electric arc supersonic wind tunnel. Three types of heat were employed: convective heat, chemical flame from an oxy-acetylene torch, and radiant heat.

The compounds were also examined under high vacuum pressures, under corona discharge, under radiation exposure, under fungus attack and other space conditions.

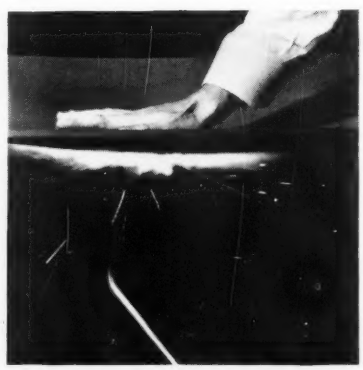
General Electric reported that little material was lost under pressures as low as 10^{-5} inches of mercury, and that there was very little loss of properties under corona discharge. Resistance to radiation was higher than for other polymers at high temperatures, it was said, and fungus resistance was complete.

In addition to use as heat-insulating materials, silicone is used in missiles in a number of ways, the researchers further reported. Silicone rubber seals are used on the steel and concrete doors which cover the silo for the Titan I missile. The seals must withstand high temperatures of the rocket blast at missile takeoff, must remain flexible even at arctic temperatures, and must have resistance to aging so that they will remain flexible during many years when the missile may not be fired.

Other uses, on missiles themselves, are in instrument door seals, hatch seals, nose cone forming blankets, nose cone gaskets, diaphragms for fuel control, and as guidance system mounts.

RTV Widely Used

Besides the applications listed, which



The insulating powers of silicone rubber are shown graphically here, as a sheet of silicone rubber 1/3-inch thick protects a man's hand from the heat of a 5,000° F. oxy-acetylene torch. Even after 60 seconds the temperature of the back portion of the sheet, under the man's hand, reached only 100° F.

are for heat-cured silicone rubber, room-temperature vulcanizing silicone rubbers are widely used for missiles, partly because they can often be used where the final shape of the part is still in question, and partly because they can be in many cases applied where wanted and cured in place.

Two uses in the Mercury capsule are for a pad for mounting electronic equipment, and for a surface seal between the ribs and outer skin of the capsule, as well as a sealant around openings and between sections.

In the Bomarc, RTV silicone is used to seal the guidance section so that its instruments can operate at normal atmospheric pressures at high altitudes, to seal the "raceway" containing wires and cables that run from one section of the missile to another, to seal off one section from another, and to act as an aerodynamic smoother on outside surfaces.

In the Minuteman missile, RTV silicone is used to cover fasteners and

boltheads in order to smooth the missile surface, to insulate metal parts from heat, and to protect rocket nozzles from rocket blast.

Uses in other missiles are similar, G-E said.

Low-temperature vulcanizing silicone rubbers can be used for potting, to protect electronic parts against vibration in addition to providing insulation. They also protect the parts against heat, corona discharge, and other factors.

Silicone rubber tapes, used in many non-missile applications, are also used to a great extent in missiles, General Electric representatives pointed out.

Silicone Fluids and Greases Used

They also discussed uses of silicone resins, fluids, and greases in various applications in missiles. The advantages of silicone fluids and greases for lubrication are that they will not evaporate in a vacuum, and that they will continue to lubricate without a film of air to assist lubrication.

C. A. Carlton

in 1917 from the University of Akron. He is a member of the American Chemical Society.

Mansfield T&R Co. Buys Abel Corp.

The Mansfield Tire & Rubber Co., Mansfield, O., has reached an agreement with the stockholders of Abel Corp., Columbus, O., to acquire Abel by an exchange of shares of stock. Abel Corp. is a merchandiser of tires and auto supplies through department stores, and Mansfield is Abel's supplier of tires.

The Abel Corp. will continue as a separate operating subsidiary of Mansfield, remaining under its present management, headed by Richard J. Abel as chief executive officer and Louis J. Krakoff, president. Policies and personnel will remain unchanged.

New Industrial Yarn

American Enka Corp., New York, N. Y., has introduced a new high modulus industrial yarn called "Suprenka Hi Mod," currently in commercial production at the company's Lowland, Tenn., plant.

The company reports that this new high-tenacity rayon yarn has been engineered for end-uses where high modulus, negligible wet or thermal shrinkage, and high strength are required. "Suprenka Hi Mod" provides excellent stability during processing because of its low shrinkage when heated or when moistened, and in use the new yarn has low growth under load, the company says.

C. A. Carlton Retires From J. M. Huber Corp.

Clinton A. Carlton has retired as manager, technical sales, industrial products, J. M. Huber Corp., Borger, Tex., after 25 years with the firm. Joining Huber in 1936, he first served as manager of development and later as technical director of rubber and new products.

During his career Carlton had 45 years tire compounding experience with Miller Rubber Co. (now a division of the B. F. Goodrich Co.), Akron, O.; Republic Rubber Co., Youngstown, O.; Kelly-Springfield (now a division of Goodyear Tire & Rubber Co.), Cumberland, Md.; and Columbia Tire & Rubber Mansfield, O.

Carlton received a B.S. in chemistry

Federal-Mogul Buys Avondale Holdings

The sale of Avondale Holdings, Ltd., Stratford, Ont., Canada, to Federal-Mogul Service, Ltd., Toronto, Ont., a subsidiary of Federal-Mogul-Bower Bearings, Inc., of Detroit, Mich., has been announced by E. T. Griffith, president of Avondale. The sale includes Avondale's three subsidiaries: G. L. Griffiths & Sons, Ltd., Federal Rubber Products, Ltd., both of Stratford, and Mechanical Rubber Products, Ltd., Mitchell, Ont. Operations of all three firms will be continued as in the past under the direction of Avondale, with Mr. Griffith as chairman of the board and C. E. Morrison as president and general manager.

Morrison said that the future growth and progress of the Avondale companies will benefit from the research facilities, the financial strength, and the world-wide marketing resources available to them through the affiliation with Federal-Mogul, and Avondale will now be able to move ahead rapidly with expansion plans.

Federal-Mogul Service, Ltd., is the sales and distribution organization for service products of the parent company, with distribution centers in Toronto and Calgary and sales branches in Vancouver, Edmonton, Winnipeg, Regina, North Bay, London, Hamilton, and Montreal.

IISRP Names Officers, Plans Brussels Office

The International Institute of Synthetic Rubber Producers will establish an office in Brussels, Belgium, according to Herman R. Thies, newly elected president.

He said that this new office "will further expand our worldwide network to promote the interests of synthetic rubber manufacturers and the public in production, engineering, safety, transportation, and other industry problems."

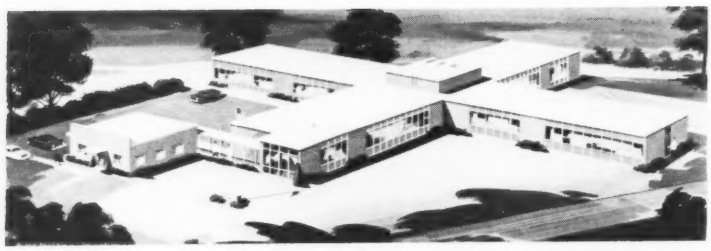
Thies, general manager of the Goodyear chemical division, Akron, O., was elected president of the Institute at the organization's second annual meeting in New York, N. Y., succeeding T. L. Cubbage, vice president of Phillips Chemical Co.

He said the Institute also is considering sponsorship of several fundamental research projects. These include investigations of test methods relating to molecular weight distribution, chemical analytical test methods for determining components of synthetic rubber and a method of determining viscosity of rubber during manufacture.

Organized in 1960, the Institute encourages development of international trade in synthetic rubbers. It also receives, prepares, and distributes information concerning the industry and cooperates with governmental departments and agencies on industry matters.

Thies, who received his master's degree in chemistry from the University of Chicago, started his career in rubber in 1930 as a research compounder. He later became assistant Goodyear research director, and in 1948, when the company organized its chemical division, he was made general manager.

Other officers elected by the Institute this year are Tara Matsuda, of Japan Synthetic Rubber Co., Ltd., vice president of the North American section; Ludwig Bornhofen of Chemische Werke Huls, vice president of the European section; George Hakim, of The General Tire & Rubber Co., secretary; and J. C. Roberts, of Firestone Synthetic Rubber & Latex Co., treasurer. Bancroft W. Henderson, managing director of the Institute, was elected assistant treasurer.



Artist's rendering of the new research laboratory for the Huber chemicals division at Havre de Grace, Md.

Huber Research Lab

The completion of a new chemicals division research laboratory and administration building at Havre de Grace, Md., in September, 1961, will mark another advance in a long-range expansion and development program instituted by J. M. Huber Corp., New York, N. Y. The new structures will augment plant facilities devoted to the manufacture of chemicals and synthetic pigments for the rubber, paint, paper, pesticide, and ink industries.

Part of the development of a five-acre site, the aluminum and brick structures will house research, technical service, and product evaluation laboratories, conference rooms, and libraries. The total area of all structures will be 32,000 square feet.

The unusual design of the new laboratory in the shape of a cross will permit adjustments in size and shape of individual laboratories. The layout will also provide quiet work areas and will eliminate the public building atmosphere generally associated with long corridors.

An additional functional advantage of the design is the centrally located utility area, which will contain the heating and air-conditioning plant, glass blowing and machine shops, sample room, and locker room. The laboratory will have radiant acoustic heating and cooling ceiling panels.

The new building will augment present Huber research facilities in Borger, Tex., and Huber, Ga.

U. S. Rubber Installs Conveyor Belt Tester

United States Rubber Co., New York, N. Y., has placed in operation a conveyor belt tester in its Passaic, N. J., plant. Designed and built by U. S. Rubber's engineers, the equipment, according to Louis J. Healey, vice president and general manager of the company's mechanical goods division, "will contribute heavily to the development of new and better belting and enable us to improve the design of individual belts to meet the needs of specific installations."

The machine is electronically controlled, weighs 100 tons, and measures 65 feet in length. It can test belts up to 140 feet long at speeds of 2,000 feet a minute, the company reports. A wide range of conditions can be simulated to evaluate types of fabrics, cover and skim thickness, flex resistance, tension rigidity, and mechanical and vulcanized belt splices, the firm reported.

R. W. Andrews Retires

Robert W. Andrews, a vice president of Brown Co., Berlin, N. H., since February, 1954, will retire on October 17, in accordance with the company's mandatory retirement policy.

Mr. Andrews joined Brown Co. as assistant to the president in March, 1952, and became works manager in July of that year. A graduate civil and mechanical engineer, he has filled a number of responsible positions both in production and in connection with capital building programs of the company. His most recent assignment was supervision of construction and operation of the company's new Bermico fiber pipe and conduit plant in Birmingham, Ala.

Prior to joining Brown Co., Mr. Andrews served as chief engineer, executive vice president, and senior vice president of Minnesota & Ontario Paper Co.

He is a graduate of the University of Maine.

Dummy Helps Prevent Back Injuries

A dummy with a trick spine is helping prevent back injuries at all plants and warehouses of Dayco Corp., Dayton, O.

Part of a long-range program to teach proper lifting techniques to employes in all divisions of the corporation, the device, introduced at the company's Dayton Industrial Products Division, Melrose Park, Ill., works on a leverage principle. There are movable joints at the ankles, knees, hips, and shoulders. The backbone is a series of wooden blocks held together by elastic strips. The employe provides the lifting power by means of a handle at the base of the dummy's spine.

With the load properly placed, the dummy's knees are bent, and the back is straight—almost vertical. When the employe applies pressure to lift the load, maximum strain is placed upon the dummy's legs instead of the back, and he reaches a standing position without mishap. But when the load is too far forward, the dummy's back is forced to bend, putting it under a strain. When the employe tries to make the dummy lift the load in this posi-

(*Continued on page 114*)

This rubber dam made by The Firestone Tire & Rubber Co., Akron, O., helps Westinghouse Electric Corp. in the flood control program at its East Pittsburgh, Pa., plant. The Fabridam, a large nylon bag coated with neoprene and inflated with water, can be deflated quickly in case of a flood to permit unobstructed runoff and increase the carrying capacity of the stream

news briefs

C. P. HALL CO. OF CALIFORNIA has constructed a new $225,000 warehouse and office building at Torrance, Calif. The plant opening is one phase in a half-million dollar expansion program of C. P. Hall Co. of Akron, O.

POLYMER CORP., LTD., Sarnia, Ont., Canada, has awarded Fluor Corp. of Canada, Ltd., the contract for the engineering, procurement, and construction of a new butadiene unit in Sarnia.

GENERAL ELECTRIC CO., silicone products department, has moved its Michigan sales office from Detroit to Oak Park. The company has also opened a sales office in Burlingame, Calif.

WESTERN PETROCHEMICAL CORP. is moving its executive offices from New York, N. Y., to Kansas City, Mo., the center of its corporate activities.

RARITAN PLASTICS CORP. has completed a 25,000-square-foot plant in Oakland, N. J.

GOODYEAR TIRE & RUBBER CO., aviation products division, Akron, O., has reported sales to the Air Force and Navy totaling $1,146,396.

REEVES BROTHERS, INC., New York, N. Y., has appointed Rockville Processing Co., Inc., Rockville, Conn., licensed laminator of its Curonized process.

ARCHER - DANIELS - MIDLAND CO., Minneapolis, Minn., has developed a binder, Aropol 7750, that is used with water to reconstitute chopped latex or urethane foam scrap. The binder is a urethane prepolymer that gives good adhesion with minimum toxicity and odor, the company reports.

THE B. F. GOODRICH CO., is establishing a new Design Center at 300 Park Ave., New York, N. Y. , for the designing, styling, and packaging of the company's products in the home furnishing, footwear, marine, construction, industrial, and automotive fields.

THE WARE CHEMICAL CORP., Westport, Conn., has appointed Beckham Co. technical sales representative in several new areas for Ware's entire line of rubber chemical "Prespersions." The coverage will be as follows: Ralph DeTurk, South-South East; James L. Weaver, Jr., Midwest; J. D. Shaw, Chicago area; H. Johnson, Buffalo-Erie area; and H. F. Jacober, West Coast.

GOODYEAR TIRE & RUBBER CO., Akron, O., celebrates the fiftieth anniversary of its plant newspaper, *Wingfoot Clan.* Issued weekly by the public relations department, the publication has a circulation of approximately 24,000.

AMERICAN CYANAMID CO., petrochemicals department headquarters, will be transferred to the company's facilities at 30 Rockefeller Plaza, New York, N. Y.

KELLY-SPRINGFIELD TIRE CO. will build a multi-million dollar tire plant near Tyler, Tex. Approximately 300 production workers and 75 office and administrative personnel will be employed.

KAUFMAN RUBBER CO., LTD., Kitchener, Ont., Canada, has purchased L. H. Packard Co., manufacturer of children's shoes and men's leather slippers.

GOODYEAR INTERNATIONAL CORP. has reached an agreement with Dunlop Rubber Co. (Malaya), Ltd., for the manufacture of a full range of Goodyear passenger and truck tires under license in a new factory Dunlop is building in Petaling Jaya, Malaya. Production in the new $25-million plant is expected to get under way in mid-1962.

AVISUN CORP., Philadelphia, Pa., has announced that the price of Olefane polypropylene film will be 64¢ per pound for all gages in shipments of 500 pounds or more. The film previously sold at 70¢ per pound in shipments of 10,000 pounds or more, and up to 73¢ per pound in shipments of 300-2,999 pounds.

GENERAL ELECTRIC CO., Waterford, N. Y., has appointed Smooth-On Mfg. Co., Jersey City, N. J., distributor of its RTV silicone rubber. The distribution territory is the East Coast, south of New England.

MARBON CHEMICAL DIVISION, Borg-Warner Corp., Washington, W. Va., has appointed Quentin Nelson & Co., Houston, Tex., its distributor throughout Texas for Marbon 9200 and 1100T MV paint resins.

PITT-CONSOL CHEMICAL CO., Newark, N. J., will soon complete construction of a new plant on its Newark site to produce a varied line of alkylated phenolic and mercaptan derivatives.

POLYMER CORP., LTD., Sarnia, Ont., Canada, has awarded a contract to Catalytic Construction of Canada, Ltd., Sarnia, for the engineering, procurement, and construction of a full-scale multi-million-dollar plant in Sarnia for the manufacture of polybutadiene.

B. F. GOODRICH INDUSTRIAL PRODUCTS CO., Akron, O., is relocating its adhesive sales office serving New England, New York, New Jersey, eastern Pennsylvania, Maryland, Virginia, and Delaware. The New York and New England areas will be served through the company's adhesive sales department established at B. F. Goodrich Sponge Products Division, Shelton, Conn. The remaining areas will be served through the B. F. Goodrich office at 955 E. Erie St., Philadelphia, Pa.

THE B. F. GOODRICH CO., will invest an additional $2,000,000 on the expansion and modernization of its Akron, O., tire production facilities. Completion is scheduled before the end of 1961.

W. R. GRACE & CO., New York, N. Y., recently applied to the Spanish Government for permission to set up a subsidiary, Darex Espanola, in Spain to manufacture synthetic rubber and plastics film. The plant will be located on the Mediterranean Coast between Valencia and Barcelona.

news about people

D. B. Clapp, Jr.

A. L. Rodee

D. B. Clapp, Jr., is now sales manager for the Pure Carbonic Co., New York, N. Y. **A. L. Rodee** will become regional manager for the Pacific region.

William F. Tuley has been appointed assistant general manager of Naugatuck-Rumianca S.p.a., an Italian chemical company jointly owned by United States Rubber Co. and Rumianca S.p.a. of Italy. He will be headquartered at Turin, where the company's plant and offices are located.

W. H. Salzenberg, general manager of the polychemicals department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., and **T. T. Miller,** president of the W. R. Grace & Co., polymer chemicals division, Clifton, N. J., have been named chairman and vice chairman, respectively, of the plastics committee of the Manufacturing Chemists' Association, Inc., Washington, D. C.

Carl St. Onge has been named orders manager for Scott Testers, Inc., Providence, R. I.

William C. Giegold has been named manager of quality control for General Electric Co., silicone products department, Waterford, N. Y. **Frank V. Summers** becomes manager of intermediates process engineering.

Donald P. Jones has become eastern sales manager of the Southworth Machine Co., Portland, Me.

David R. Fulton, Sr., is now vice president, tire valve operations, of Bridgeport Brass Co., Bridgeport, Conn.

Gilbert D. Gingold becomes manager of technical services, of the newly created technical service department, Sid Richardson Carbon Co., Fort Worth, Tex. He will also serve as manager of the company's laboratory facilities at the new ISAF-HAF furnace plant in Big Spring, Tex.

G. D. Gingold

A. G. Treadgold

A. G. Treadgold, vice president, manufacturing, United Carbon Co., Houston, Tex., has been elected treasurer of the company, succeeding **T. A. Whelan.** Treadgold continues as vice president in charge of manufacturing.

John F. Murphy has been made representative in charge of the Chicago area for American Zinc Sales Co., St. Louis, Mo.

Everett Sklarz is now eastern regional sales manager for the chemical group, Archer-Daniels-Midland Co., Minneapolis, Minn.

Philip G. Sutton, Jr., has been made sales representative of the pigments division of American Cyanamid Co. at the company's Boston office.

William George Swalwell is now with the industrial chemicals department of Commercial Solvents Corp., at its Agnew, Calif., office.

Josiah D. Crosby has joined the senior professional staff of Arthur D. Little, Inc., Cambridge, Mass.

Peter J. Marcello, vice president in charge of operations of Acme-Hamilton Mfg. Corp., New York, N. Y., has been elected a director of the company.

G. D. Jackson III

B. E. McCardle

Glenn D. Jackson III, formerly responsible for Georgia and Florida, now will serve Pennsylvania, Maryland, Delaware, and Virginia for Dewey & Almy Chemical Division, W. R. Grace & Co., Cambridge, Mass. **Billy E. McCardle,** formerly responsible for Texas, Oklahoma, Louisiana, Arkansas, Mississippi, and western Tennessee, assumes responsibility for Florida, Georgia, Alabama, and eastern Tennessee.

W. H. Schmalz has been made general manager, Dominion Rubber Co., Ltd., general products division Montreal, P.Q., Canada. **J. R. Falconer** becomes general manager, footwear division. Both appointments follow the retirement, after nearly 49 years of service, of **H. Wolfhard,** vice president and general manager of the footwear and general products division.

Robert S. Sweet has been added as New England technical sales representative for Schenectady Varnish Co., Inc., Schenectady, N. Y.

Robert B. Blodgett has been appointed director of research of The Okonite Co., Passaic, N. J., wire and cable fabricating subsidiary of Kennecott Copper Corp. **Richard C. Waldron** becomes chief engineer.

Henry P. Stockbridge has been named to the new position of director-new product planning for The B. F. Goodrich Co., Akron, O.

Clinton E. Little, president of Servus Rubber Co., Rock Island, Ill., was honored at a dinner held recently in Davenport, Iowa, for 60 years of service in the rubber footwear industry.

M. M. Kahn

C. F. Hogan

Marvin M. Kahn, vice president of Acme-Hamilton Mfg. Corp., New York, N. Y., has been appointed director of research, development, and engineering. **Edward V. Ecklund** is now treasurer of the company.

Coleman F. Hogan was elected president of Davidson Rubber Co., Dover, N. H. He succeeds **Mrs. Virginia P. Dee** who resigned as president but will continue to serve as treasurer.

Stephen J. Groszos has been named technical director, and **Ramon A. Mulholland** director of commercial development, in the research and development division of The Richardson Co., Melrose Park, Ill. Other appointments include: **Gilbert Gavlin,** manager of basic products department; **Thomas E. Ronay,** manager of proprietary products department; **Robert J. Wentland,** administrative assistant to technical director. **Kiyo Hattori,** senior chemist, and **Robert C. Medl,** senior engineer, continue in staff positions, reporting to the managers. Section supervisors appointed were: **William M. Boyer,** chemicals; **Edward A. Hedman** polymers; **Selwyn R. Mather,** formed products; **Robert D. Dexheimer,** specialty products; **Samuel Shore,** analytical and testing.

Louis K. Lukity becomes technical superintendent of Hamilton Kent Mfg. Co., Kent, O.

Donald E. Schick has been appointed marketing coordinator for the Paramins division of Enjay Chemical Co., a division of Humble Refining Co., New York, N. Y. Schick replaces **Gordon C. Seeler,** now head of the additives section at the Enjay Laboratories, Linden, N. J.

Henry A. Hill becomes president of Riverside Research Laboratory, Inc., Cambridge, Mass.

John A. Edwards has been named executive vice president, and **William A. Runge** has been appointed comptroller of the Liquid Carbonic Division, General Dynamics Corp., Chicago, Ill.

C. E. Wilson has been made vice president and general manager of Pacific Moulded Products Co., Los Angeles, Calif.

C. J. Schmidt

C. E. Wilson

Chester J. Schmidt retires as vice president and general manager of the J. O. Ross Engineering Division of Midland-Ross Corp., New York, N. Y. **Robert J. Jacobs,** vice president and general manager of the Waldron-Hartig Division of Midland-Ross, will temporarily assume also the general management responsibilities for the Ross division.

F. M. Chapman

W. Wade

Frank M. Chapman is now general manager of the fluorocarbon division of Plastic & Rubber Products Co., Los Angeles, Calif.

Charles R. Spencer was named manager of the automotive-hardware sales division of the Gates Rubber Co., Denver, Colo.

W. E. Boruff becomes manager, new products applications, The General Tire & Rubber Co., chemical division, Akron, O.

John W. H. Miner, president, Miner Rubber Co., Ltd., Granby, P.Q., was elected vice chairman of the Quebec Division of the Canadian Manufacturers Association.

Robert M. Barr is now district sales representative for Sinclair Petrochemicals, Inc., New York, N. Y., with headquarters in Atlanta, Ga.

W. R. Macy

Pach Bros., N. Y.

W. H. Spratling

William H. Spratling has been named director of purchases for United States Rubber Co., New York, N. Y. He succeeds **Stanley W. MacKenzie,** who has retired.

William R. Macy has been named manager of the reclaim rubber laboratory of B. F. Goodrich Industrial Products Co., Akron, O., to succeed **Earl Busenburg,** retired.

Roger M. Nagel has been promoted to supervisor of polyolefin development for Petro-Tex Chemical Corp., jointly owned by Food Machinery & Chemical Corp. and Tennessee Gas Transmission Co. His office will remain at Food Machinery's chemical research and development center, Princeton, N. J.

William Wade has been elected a vice president and technical director of Acme-Hamilton Mfg. Corp., New York, N. Y.

Norman P. Ottley has been appointed general purchasing agent for raw materials and fuels for all divisions of Witco Chemical Co., Inc., New York, N. Y.

Richard I. De Vine is now product manager, tire yarn and its industrial uses, for Beaunit Mills, Inc., fibers division, New York, N. Y.

Ralph L. Hanna, supervisor of training for The B. F. Goodrich Co., Akron, O., for the past year, has become manager of training and personnel research for the company.

R. E. Dobbin, formerly director of research and development of the western region of Cabot Corp., Boston, Mass., is now general superintendent for carbon black manufacturing, carbon black division, of the company's western region. **N. Dudley Steele,** formerly in the production department of the western region's carbon black division, has been appointed director of research, development, and technical service, western region.

news about people

Dewey D. Billodeau was appointed plant manager of the new $5,000,000 carbon black plant of United Carbon Co., in Port Jerome, near LeHavre in northern France.

H. Wolfhard, vice-president and general manager of the footwear division and general products division, Dominion Rubber Co., Ltd., Montreal, P.Q., Canada, has retired after 48 years with the company. **J. R. Falconer,** previously manager of the footwear division, becomes general manager of the division, with headquarters in Montreal. **W. H. Schmalz,** previously manager of the general products division, has been made general manager of that division, with headquarters at Kitchener, Ont.

Robert E. Purcell is now sales manager for phosphorus chemicals in the mineral products division of Food Machinery & Chemical Corp., New York, N. Y. **Robert J. Mawe** succeeds him as district sales manager in Chicago; while **Michael T. Dwyer** will occupy Mawe's former position as district sales manager in Cincinnati.

Malcom Kidd, Paul E. Nemececk, Wayne E. Law, and **William E. Wells** have been appointed field engineers with the industrial division of Dayco Corp., with headquarters in the company's new Springday V-belt plant at Springfield, Mo.

Richard C. Willson, Jr., has been made technical service manager for Isotron products, Pennsalt Chemicals Corp., Philadelphia, Pa. **Allen B. Reed, Jr.,** has been named supervisor of the Isotron aerosol laboratory.

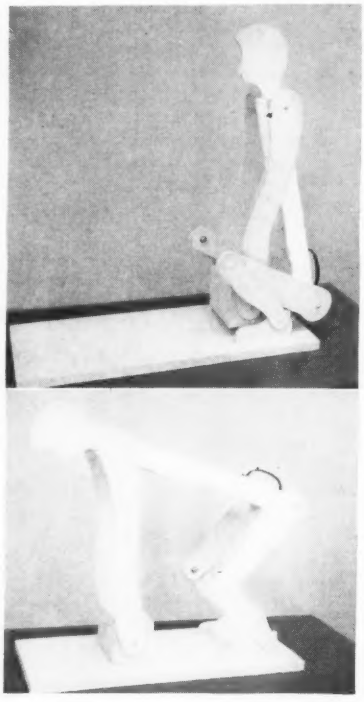
Edward L. Ruffin has been appointed regional credit coordinator for the Esso region of Humble Oil & Refining Co., New York, N. Y. He succeeds **Frank J. Hutchings,** recently transferred from New York to Houston, Tex., as company-wide credit coordinator in the newly created marketing department at Humble Oil & Refining headquarters.

Dale W. Laudenslager is now manager of the new chemical center of Archer-Daniels-Midland Co. at Peoria, Ill. **Herbert F. Davidson** was named operations coordinator for the company's chemical group plants at Los Angeles, Calif., Valley Park, Mo., Pensacola, Fla., Newark and Elizabeth, N. J., Ashtabula, O., Wyandotte, Mich., and the chemical center at Peoria. **Orlando Graziani** becomes operations engineer for the entire chemical group, with primary responsibility for process studies and other engineering assignments.

Back Injuries

(Continued from page 110)

Proper lifting technique



Improper lifting technique

tion the extra stress causes the backbone sections to separate.

The misfortune which befalls the dummy is startling, but is not without its comical side. Virtually every person seeing the demonstration for the first time is inclined to laugh when the backbones part company. The laughter, however, is quickly replaced with the sobering realization that this is what frequently happens to the human spine. The lesson goes home with a dramatic and telling effect.

Firestone Tire & Rubber Co., Akron, O., has developed a 12-ton mechanical rig to test large heavy tractor tires by exerting extreme loads on the tires to determine load-carrying capacities and torque transmission abilities. Consisting of a steel frame set in a cement slab and mounted on an axle, the rig, called "Mighty Mo", is towed by a tractor equipped with special adapters to hold a number of 145-pound disk weights.

United Carbon To Build Research Center

United Carbon Co., New York, N. Y., has awarded a contract for construction of a new $2-million research center to be erected just outside Houston, Tex., to W. R. Grimshaw Construction Co., Houston.

"The new centralized facilities will enable United to better coordinate its research and development work in the carbon black, synthetic rubber, polymer and petrochemical fields," stated John H. McKenzie, vice president, research and development.

The initial three-building unit will include a one-story laboratory with adjacent facilities for small-scale development work, and a central quality control laboratory. Completion of the research center is scheduled for Spring, 1962.

Group Outings

(Continued from page 98)

and members in attendance, and trophies was awarded for the golf tournament. Low gross went to Gene Becker (General Tire); high gross, to E. Helmbrecht (Hewitt-Robins); and longest drive to Nick Johnson (Socony Mobil).

The next meeting is scheduled at the Hotel Westbrook on October 10, speaker and subject to be announced.

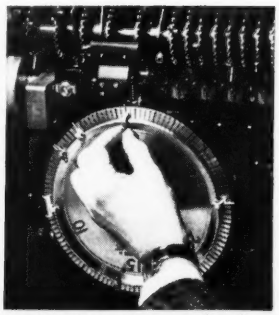
WRG Outing

The Washington Rubber Group held its annual outing, June 23, at Brooke Manor Country Club, just outside Washington near Norbeck, Md. The final affair of the 1960-61 WRG season, the outing offered members their choice of entertainment—golf, swimming, badminton, softball, a horseshoe pitching contest, and bingo. The get-together, managed by Outing Chairman George Wingate, of Goodyear, who was assisted by other members of WRG, was topped off by a buffet supper at 7:00 p.m.

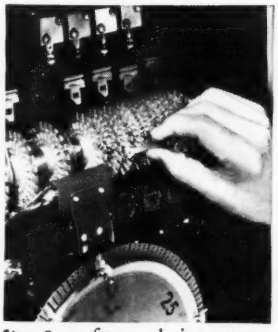
WRG's membership roster for 1960, prepared by 1961-62 Secretary Dan Pratt, of the Navy Bureau of Ships, came off the presses last month.

New Taylor **FLEX-O-TIMER®** *Timed-Program Controller...*

gives you—



Program Trip Pins are simply placed at selected intervals, set screws tightened with an Allen wrench.



Step Cams fit snugly into step disc notches, are easily bolted into place, never have to be adjusted.

- Up to 12 pneumatic and/or electric functions
- Faster, easier setting of Program Trip Pins
- Positive acting air valves with more than 3 times previous output capacity

Recognized for many years as a highly versatile "robot brain" for the precise timing and coordination of batch processes, this new FLEX-O-TIMER Controller has been made even more simple to operate, more precise in its control. It is ideal for providing completely automatic time control for tire presses, particularly for nylon cord tires requiring additional functions; platen presses; or any process requiring precise timing of process sequence and duration involving temperature, pressure, mechanical motion, electrical energy, or any combination thereof.

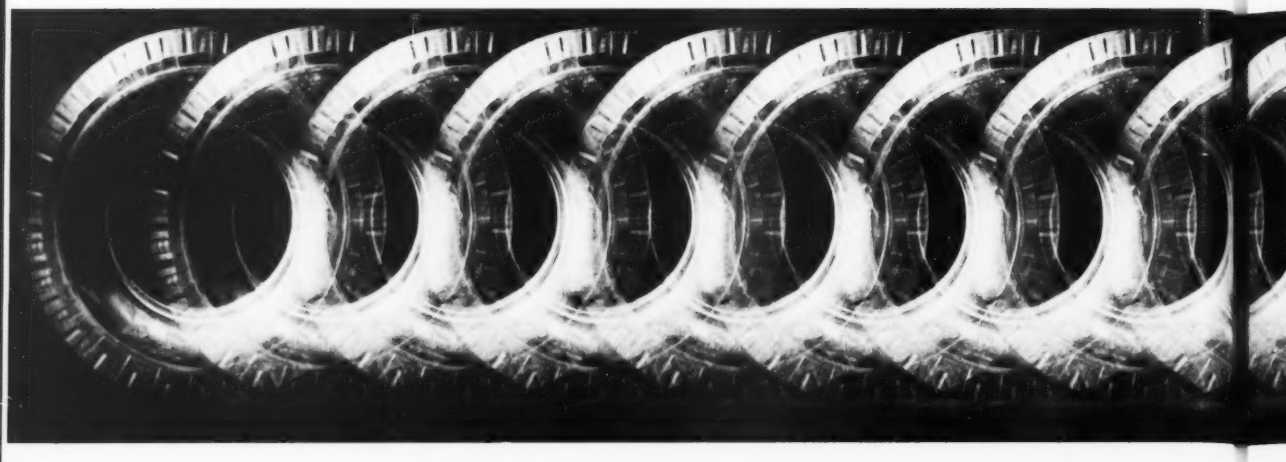
As well as the three major improvements listed above, the new FLEX-O-TIMER Controller incorporates these plus features:

- Extremely short time intervals between steps (with high accuracy) can be accommodated . . . 7½ seconds on 30 minute cycle dial; minimums on other dials in same ratio.
- Cycle range is quickly adjustable for 15 to 60 minutes for high-speed range. 1 to 16 hours for low-speed range.
- Time dial automatically resets to zero in maximum of 13 seconds at completion of cycle.

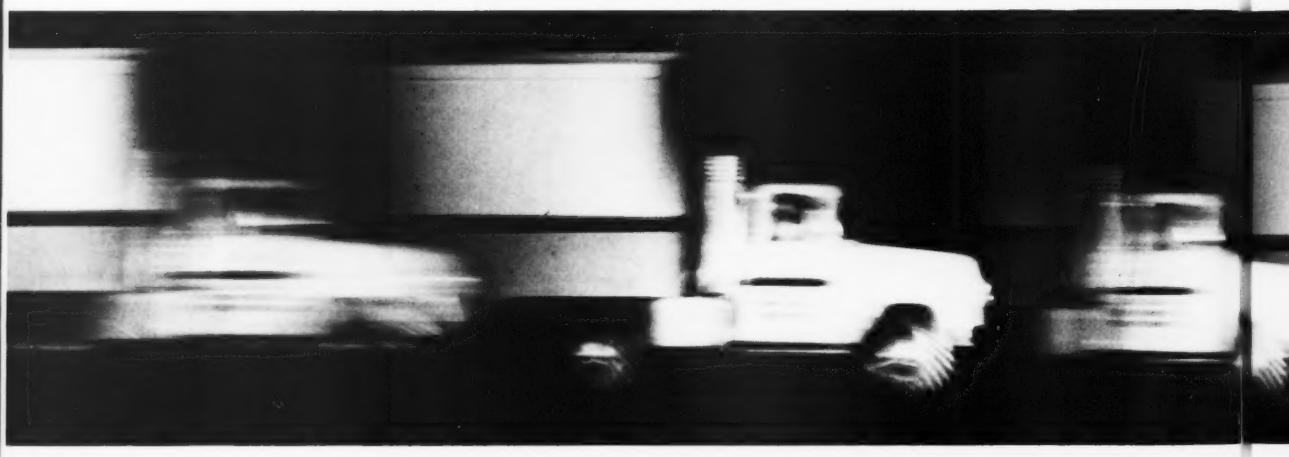
Ask your Taylor Field Engineer for full details, or write for **Bulletin 98373.** Taylor Instrument Companies, Rochester, New York, and Toronto, Ontario

Taylor Instruments MEAN ACCURACY FIRST

You get lower compound costs ti



Your customers get better tread w



With Phillips Revolutionary new

PHILLIPS 66

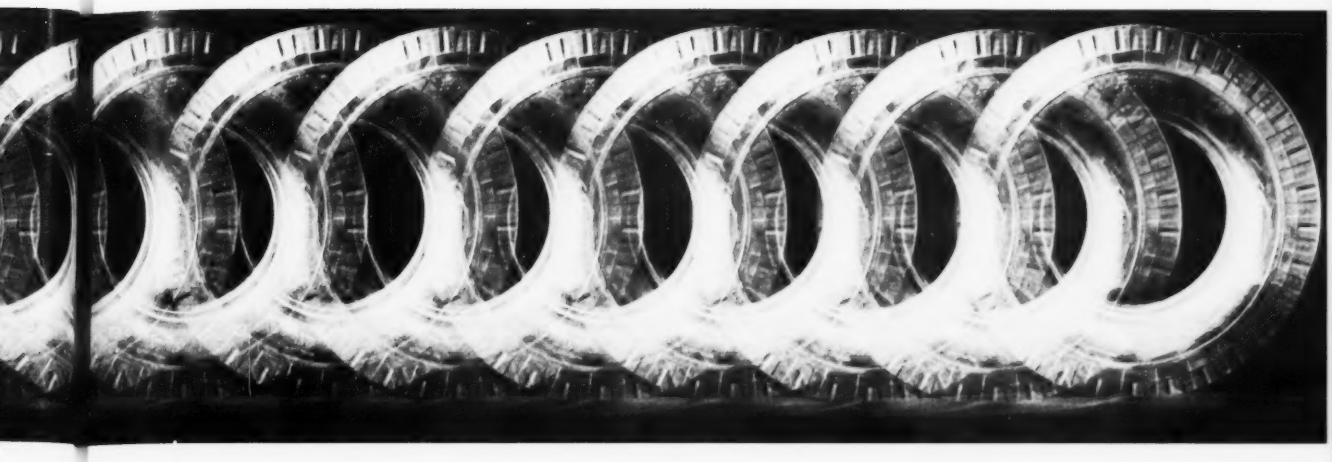
CIS-4 RUBBER, proved in over 3 million miles of road tests—

now in full production at Phillips Borger plant. Order your shipment of Cis-4 Rubber today—for low compound costs, improved tire performance.

PHILLIPS CHEMICAL COMPANY

Rubber Chemical Sales Division, 318 Water St., Akron 8, Ohio. Sales Offices: Akron, Chicago, Dallas, Providence and Trenton. **West Coast:** Harwick Standard Chemical Co., Los Angeles, Calif. **Export Sales:** Phillips Petroleum International Corporation, Sumatrastrasse 27, Zurich 6, Switzerland. Distributors of Phillips Chemical Company Products, 80 Broadway, New York 5, N. Y.

sts tire after tire after tire



ead wear mile after mile after mile

ew—CIS-4* RUBBER

Here it is . . . Cis-4, the amazing new synthetic from Phillips Chemical Company. Extensive road testing and compounding proved: Cis-4 gives low compound costs, plus more tread miles per dollar.

Cis-4 has a unique capacity for tolerating high oil levels. Improved processing can be obtained through the use of selective oil and black combinations.

*A trademark

ADD "BROWN" TYPE

Factice®

VULCANIZED VEGETABLE OIL
TO YOUR COMPOUND

"BROWN"

for High Speed Extrusion and Faster Curing

Typical products using Factice® "Brown" in compounding formulas.

The brown types of Factice® are made from various vegetable oils by vulcanizing with sulphur and heat. The choice of the proper grade of brown Factice® to be used in a compound is highly important. The percentage to be used depends on the type of formulation and softness desired.

The brown types are compatible with crude rubber, Neoprene, Buna S and Buna N type polymers. Send us your compounding formula for our suggestions. All formulas held in strict confidence. Our trained staff will help in selecting the proper vulcanized vegetable oil for your need . . . Factice® White, Brown, Neophax or Amberex.

THE STAMFORD RUBBER SUPPLY CO.
STAMFORD, CONN.

THE SECRET IS OUT . . . EEMCO engineers announce the "Unit-drive" for mills, an entirely new concept in mill drives that is eight ways better.

It is quiet running, vibration proof and all lubrication difficulties have been eliminated.

The EEMCO "Unit-drive" mill, mounted on a unified base, can be installed at reduced cost and requires considerably less floor space. Higher operating efficiency at lower maintenance expense added to the points listed above make EEMCO's "Unit-drive" mills today's top equipment topic.

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news from abroad

U. S. Foreign Trade Pattern Reversed In Rubber Field During Past Decade

During the past 10 years the foreign trade pattern of the United States has undergone almost a complete reversal, figures of the United States Department of Commerce show.

Formerly an exporter of rubber products, with only a minor amount of raw materials exported, the United States now exports nearly twice as much synthetic rubber and other rubber industry raw materials as it does rubber products, exporting only slightly less rubber than it imports (Table 1).

At the same time the United States has become a sizable importer of rubber products, particularly in two categories of tires and tire products, and shoes and shoe products (Table 2). As late as 1949, rubber products were less than 2% of total imports; the remainder was natural rubber. In 1960, it is estimated, natural rubber was only 70% of total imports, and rubber products 30%. (See Table 3.)

For every dollar of raw materials it exported in the 1935-37 period, the United States imported $30.3. In 1956 it imported $3.6 of raw materials for every dollar exported; in 1957, $2.7; in 1959, $2; and in 1960 an estimated $1.8.

For every dollar of rubber products it imported in the same years the

TABLE 1. U. S. EXPORTS OF DOMESTIC AND FOREIGN MERCHANDISE, RUBBER AND RUBBER PRODUCTS, 1935-60

[Value in Dollars]

Material	1935-37 Average	1949	1956	1957	1958	1959	Jan.-Oct., 1960
Grand total	25,945,071	117,321,253	277,301,468	309,572,325	290,961,815	341,795,862	331,517,338
Raw materials, total	5,879,415	12,566,560	111,220,267	133,696,473	140,682,245	198,498,759	202,041,440
S-type	.....	735,758	61,697,524	79,566,065	69,756,344	107,187,887	109,456,384
Neoprene	.....	2,589,534	21,049,555	29,176,702	29,862,433	38,187,671	40,812,650
Other	5,879,415	9,241,268	28,473,188	24,953,706	41,063,468	53,123,201	51,772,406
Products, total	20,065,656	104,754,693	166,081,201	175,875,852	150,279,570	143,297,103	129,475,898
Tires and products	13,147,732	71,098,797	104,940,010	109,143,668	94,890,625	85,566,663	78,843,463
Shoes and shoe products	937,754	3,042,884	5,024,130	5,105,653	4,071,950	4,677,719	2,927,190
Belting	1,596,878	6,702,658	8,075,196	7,132,974	7,424,834	6,583,470	4,784,953
Hose and tubing	1,678,686	4,782,441	9,723,026	10,229,129	8,351,809	8,372,586	8,399,448
Other	2,708,606	19,127,913	38,318,839	44,264,428	35,540,352	38,096,665	34,520,844

Source: Bureau of the Census, U. S. Department of Commerce.

TABLE 2. U. S. IMPORTS FOR CONSUMPTION, RUBBER AND RUBBER PRODUCTS, 1935-60

[Value in Dollars]

Material	1935-37 Average*	1949*	1956	1957	1958	1959	Jan.-Oct., 1960
Grand total	179,730,337	251,328,219	422,621,523	381,270,455	292,855,144	490,324,295	403,430,738
Raw materials, total	177,897,490	249,559,432	402,463,242	357,385,946	256,437,560	390,821,057	286,875,240
Natural	175,111,592	240,311,937	398,018,852	349,712,662	248,174,106	382,501,191	277,901,462
Other	2,785,898	9,247,495	4,444,390	7,673,284	8,263,454	8,319,866	8,973,778
Products, total	1,832,847	1,768,787	20,158,281	23,884,509	36,417,584	99,503,238	116,555,498
Tires and products	174,803	73,585	6,037,733	10,109,239	13,285,197	26,055,874	17,000,869
Shoe and shoe products	243,536	632,099	1,827,855	4,712,169	11,494,198	47,514,437	73,672,647
Belting	†	76,455	370,643	430,437	354,060	625,016	758,386
Hose and tubing	†	13,125	403,639	281,055	301,102	476,920	1,919,046
Other	‡1,414,508	973,523	11,518,411	8,351,609	10,983,027	24,830,991	23,204,550

* Data before 1956 are not strictly comparable, but differences are slight.
† Included in "Other."
‡ Includes belting and hose and tubing.
Source: Bureau of the Census, U. S. Department of Commerce.

TABLE 3. U. S. IMPORTS OF RUBBER AND RUBBER PRODUCTS, BY COUNTRY OF ORIGIN, 1959

[Thousand Dollars]

Origin	Natural Rubber	Auto Tires	Shoes and Shoe Products
Total	382,501	22,722	47,626
Malaya	110,012	.....	.....
Indonesia	96,709	.....	.....
Thailand	70,130	.....	.....
Liberia	28,899	.....	.....
Singapore	22,110	.....	.....
Cambodia	12,813	.....	.....
Congo	10,834	.....	.....
Canada	.....	7,429	73
United Kingdom	40	2,261	604
France	43	10,893	637
Japan	25	34	39,238
Hong Kong	.....	.....	4,160
Other	30,886	2,105	2,904

Source: Bureau of the Census, U. S. Department of Commerce.

U.S.A. exported $10.9 in 1935-37, $8.2 in 1956, $7.4 in 1957, $4.1 in 1958, $1.4 in 1959, and only $1.1 in 1960.

Exports of rubber products, which represented about 77% of total exports of rubber and rubber products in the 1935-37 period, and nearly 88% in 1949, declined to 60% in 1956 and to 42% in 1959, with an estimated drop to 40% in 1960. (See Table 3.)

In 1953, only 2.3% of U. S. synthetic rubber production was exported. The percentage climbed from 5.4% in 1954 to 10.6% in 1955, 15.1% in 1956, 19.9% in 1957, 18.8% in 1958, 21.1% in 1959, and an estimated 23.3% in 1960. (Table 4.)

TABLE 4. U. S. EXPORTS OF SYNTHETIC RUBBER AS A PERCENTAGE OF TOTAL PRODUCTION (INCLUDES LATEX), 1953-60

Year	All Types	S-Type	Neoprene	N-Type	Butyl
1953	2.8	1.1	14.3	16.1	0.3
1954	5.4	2.3	17.4	19.4	4.9
1955	10.6	7.7	19.8	14.1	17.9
1956	15.1	12.9	22.0	18.2	11.6
1957	19.9	17.4	27.3	19.3	13.2
1958	18.4	16.3	32.0	21.0	26.4
1959	21.1	19.5	31.9	19.4	26.9
1960*	23.5	22.0	37.5	21.5	27.5

* Estimated from 11-month figures.
Source: Bureau of the Census, U. S. Department of Commerce.

By rubbers, 22% of all SBR was exported in 1960, 21.5% of NBR, 27.5% of butyl, and 37.5% of neoprene. Most of the rubber exported is SBR, $107.2 million worth in 1959, but there was a sizable $38.2 million worth of neoprene exported in the same year. Although markets for SBR may drop because of plant construction in Western Europe and Japan, exports of neoprene, NBR, and butyl should continue high, the Department of Commerce predicts.

About 15% of the $99.5 million of U. S. imports of rubber products in 1959 were in tires and tire products, mainly from France, Canada, and the United Kingdom. Most of the shoes and shoe products imported, about $73.7 million, or about 70% of the total, were from Japan, with some from Hong Kong. (Table 3.)

The largest amount of synthetic rubber is exported to France, a total of $25.6 million, with Japan second with $19 million, and Canada third with $15 million. Turkey, Iran, Korea, Taiwan, and other countries receiving aid are the main markets for U. S. tires, with importers of U. S. synthetic rubber not being the main importers of U. S. tires. The sole exception is Canada, which imports $3.6 million worth of tires (Table 5).

TABLE 5. U. S. EXPORTS OF RUBBER AND RUBBER PRODUCTS, BY DESTINATION, 1959

[Thousand Dollars]

Destination	S-Type	Neoprene	Tires, Truck and Bus	Tires, Off-the-Road
Total	107,188	38,188	38,240	21,060
Canada	12,022	2,970	1,058	2,586
Belgium	2,493	7,080	42	152
United Kingdom	4,207	5,618	50	48
France	20,066	5,559	106	49
West Germany	8,474	4,326	15	135
Turkey	90	10	3,914	1,145
Iran	.....	.....	3,846	4,553
Japan	14,116	4,822	123	12
Australia	6,787	1,002	48	61
Ecuador	.....	.....	1,315	423
Greece	87	52	2,118	580
Korea	12	5	5,545	17
Taiwan	92	34	4,521	105
Other	38,742	6,710	15,539	11,195

Source: Bureau of the Census, U. S. Department of Commerce.

NUPW Labor Proposals

Toward the end of April the National Union of Plantation Workers (NUPW) submitted new proposals on wages and working conditions to the Malayan Planting Industries Employers' Association (MPIEA). No exact details as to wage demands were published, but the Union did state that though there had been no complaints as to the agreement on the wage structure in force since June, 1959, workers have been very disappointed over their lower earnings in recent months, especially when rubber prices dipped below 80 cents (Malayan).

At the annual MPIEA meeting at the end of May, the president, T. G. Jenkins, explained the stand of employers on the new proposals. He emphasized that while the Association was not automatically against higher wages, it insisted on a corresponding increase in productivity by workers. In the face of synthetic progress, it would be suicidal to the industry to do otherwise, and also against the long-term interest of the workers themselves. At the same time, he pointed out that the large potential increase in total production in the next few years, resulting from replanting and new planting, promised increased earnings for tappers.

Jenkins was pleased to add that during the year there had been markedly fewer wildcat strikes and resulting loss of man-days, which suggested a growing appreciation by Union officials of the "voluntary" system of settling differences, and he praised the government's efforts in behalf of collective bargaining.

He also approved the proposal to apply agreements by representative organizations on wages and working conditions to employers and workers in the same industry, who do not belong to these organizations. This, it seems, refers to the many larger estates, chiefly Asian, which do not belong to the MPIEA and are said to discourage union activities.

Replying to a claim by the All-Malayan Estates Staff Union that vacancies for state assistants should be filled by promotion from the ranks of the staff, Mr. Jenkins stressed that this was a matter for the employer to decide and could not be the subject of discussion or agreement between the MPIEA and the AMESU; but he added that employers do consider for promotion members of the staff of proved ability, and that many men of managerial level had graduated from the ranks.

Further negotiations between the employers and Union will be resumed by the end of July.

U. S. Overstocks Cut Japanese Zori Exports

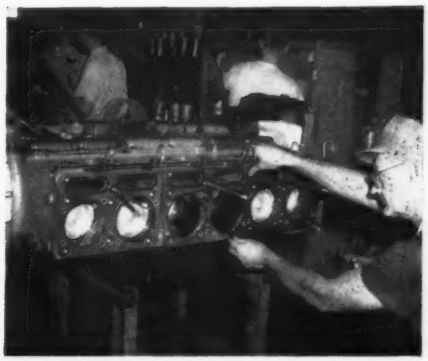
Exports of Japanese zori, or rubber beach sandals, dropped off sharply in the last quarter of 1960 and the first quarter of 1961 because of a heavy overstock in U. S. warehouses, the U. S. Department of Commerce reported.

It was estimated that some 70 million pairs of zori are in U. S. warehouses, and that it will take a year to 18 months to work off the oversupply.

To avoid cutting back on production, some manufacturers are reported going in for production of "pocket shoes," lightweight, flexible slippers consisting of thin leather uppers and sponge soles. These shoes, which cost about 50¢, are in increasing use by travelers because they can be folded and carried in a pocket or purse.

SILICONE NEWS from Dow Corning

Longer Life for Engines



Oil seals, diaphragms, and many other automotive parts are fabricated of long-lasting Silastic, too. Original physical properties are essentially retained in temperatures from —130 to 500 F; resist oxidation, weathering, moisture and compression set. Silastic stays rubbery under the most adverse operating conditions — provides a combination of properties that permit components of this "talented" material to meet rigid performance requirements.

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Grommets of Silastic Withstand 350F; Effectively Seal Coolants

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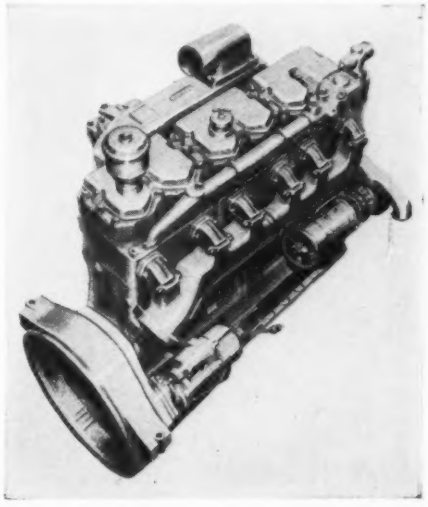
A factor in the performance of their engines is a set of 24 cylinder-head grommets made of Silastic®, the Dow Corning silicone rubber. The grommets proved so effective in Cummins' new engines, they are now specified as standard components on other models throughout the Cummins line. These resilient silicone rubber rings are positioned over the entrances to coolant passages in the top of the block. They prevent leakage of coolant and antifreeze into the engine and the costly damage that could result. The grommets snap into the cylinder head gasket where they remain flexible and sure-sealing, despite attack by cooling fluids and engine temperatures in the 300 to 350 F range.



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Japanese manufacturers expect a sustained high level of exports for zori after the present inventory is worked off, although there is still considerable concern over flooding of the market, which dropped prices from about $1.75 a pair in 1957 to less than $1 by the end of 1959, and which resulted in prices dropping as low as 29¢ in some U. S. stores.

The zori began to be imported about 1955, and exports rose from 3.6 million pairs in 1956 to 68 million pairs in 1959. As the result of a meeting of Japanese manufacturers in February, 1960, exports to the United States were limited to 73 million pairs. The restriction, however, had come too late to do much about the oversupply. In September, 1960, the Rubber Products Committee of the Japan General Merchandise Association announced a reduction in quotas by 40% to 45 million pairs for the period April 1, 1960, to March 31, 1961. But more than 35 million pairs had already been exported for the period.

The problem for Japanese manufacturers is that production is rarely cut back in Japan. Workers are not usually dropped until they retire.

Although there is little or no production of Japanese-type zori in the United States, this type of footwear competes with other types of U. S. footwear.

TABLE 1. RUBBER ZORI PRODUCTION AND EXPORTS, 1956-60

(Quantity in Thousand Pairs; Value in Thousand Dollars)

Year	Produced Quantity	Exported Quantity	Value of Exports
1956	13,500	3,600	1,000
1957	21,300	10,000	3,000
1958	37,200	24,900	7,300
1959	80,000	68,000	20,000
1960	....	65,170	12,928

TABLE 2. EXPORTS, JANUARY-AUGUST, 1960

Month	Quantity (1,000 Pairs)	Value ($1,000)
Jan.	7,060	1,405
Feb.	10,800	2,345
Mar.	12,300	2,280
Apr.	11,450	2,290
May	11,700	2,280
June	5,530	1,120
July	2,720	570
Aug.	3,610	638

RGA Chairman Looks At NR World Picture

In his speech at the annual general meeting of the Rubber Growers' Association, held in London, England, May 19, the retiring chairman, W. Anderson, looked at both the dark and the bright side in discussing the problems facing rubber producers.

Whereas in 1959 synthetic rubber constituted less than half of the non-Communists world's consumption, the proportions for natural and synthetic rubber in 1960 were reversed, and for the first time under peacetime conditions, more synthetic rubber was used than natural, he pointed out. But what was particularly disturbing, he went on, was that the conventional SBR rubbers made this encroachment. Now *cis*-polyisoprene and *cis*-polybutadiene have appeared on the market; neither is as yet perfected, but they would not remain so, and it would be imprudent not to regard them as providing means of replacing natural rubber in every field of rubber consumption.

In the competition between the natural and synthetic rubbers, it is no longer a question of superior or inferior properties, he stressed, but simply a matter of economics, and the goal for the rubber producer must be reduction in costs to insure the supply of demand at a stable price, if necessary at a low level. New types of natural rubber can only help the situation if produced at a competitive price, because with the advent of *cis*-polyisoprene any new form of natural rubber can eventually be duplicated by synthetic "natural." Rubber growers must increase production to cut costs. Many estates, by replanting with high-yielding material, are in a position to sell rubber profitably at today's price for synthetic, and even at a substantially lower price, if intensified competition leads to price cutting by synthetic rubber manufacturers.

Here the policy of oil companies enters, since the chief factor in the cost of synthetic production is the cost of raw materials from oil. The oil companies may reduce their prices, or, on the other hand, they may consider that a sharply reduced economy in the rubber-producing areas resulting from synthetic competition endangers their own business in those areas. Apart from this point, there must be a limit below which the supply of raw materials for synthetic rubber ceases to be profitable to oil companies.

In this connection Anderson quoted one of the largest producers of synthetic rubber as saying that there is no synthetic rubber, nor is the development of a synthetic rubber foreseeable, able to compete with efficiently produced natural rubber for general-purpose use.

Synthetic rubber is produced in highly developed countries, he went on, and it is hardly likely that they will use their resources to enable synthetic rubber to engage in cut-throat competition with natural rubber, the main prop in the economy of so-called underdeveloped countries.

He concluded on a note of restrained optimism: "Of one thing I am certain, and that is that despite all our problems, natural rubber can meet and beat any challenge that may come from synthetic. It will do so if we . . . make the best use of the results achieved by our research workers . . . and if we have the full support of the governments of the producing areas and of organized labor."

Need Improved Butyl For Belts and Linings

The chief application of butyl rubber at Billingham Division of Imperial Chemical Industries, Ltd., is in conveyor belts for handling fertilizer and other inorganic materials under various conditions, and anti-corrosion plant linings. Butyl rubber has given good service at Billingham, but certain improvements are still necessary, L. T. Butt points out in a paper presented at a Symposium on Butyl Rubber held last year at the National College of Rubber Technology, London, England, and reported on by *Rubber and Plastics Age* (May, 1961, p. 528).

The suggested improvements in the case of conveyor belts are:

1. Higher adhesion values between cover and plies both of cotton and Terylene ducks.
2. Cover compounds having increased abrasion resistance.
3. A further increase in the heat resistance of cover compounds (say to 150° C.) without sacrifice on their present good qualities.

As to butyl rubber linings, the development of low-temperature curing stocks would be of considerable interest to end-users.

It is noted that some of these points are already being investigated, with some success, and it is hoped that advances will soon be made available to the end-user.

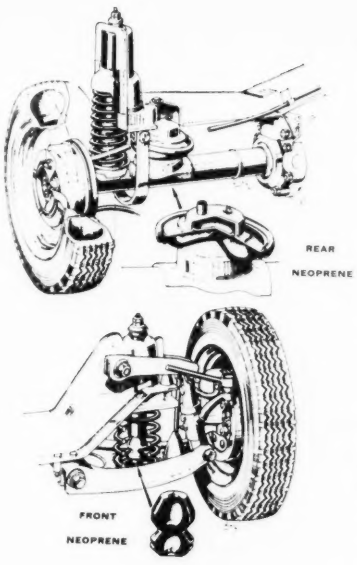
Neoprene in Automotive Suspension System

Neoprene is being used in a new automotive suspension system which features steel coil springs in combination with neoprene air-supported cushions for each wheel.

Patented by Regie Nationale des Usines Renault, Billancourt/Seine, France, the new system utilizes the coil steel springs for smooth riding. As the load or number of passengers is increased, however, the neoprene air cushions give additional support to the springs, thus preventing bottoming of the car and excessive sway in cornering.

Renault reports that neoprene was the only rubber found suitable during the more than four years of developmental work and road testing under a wide range of climates and driving conditions. The company further states that there was not a single instance of cracking or breaking of the neoprene cushions during the road testing period.

Before its adoption, neoprene met rigid specifications including good aging



Front and rear suspension units with neoprene air cushions

properties, good air retention, resistance to oil and salt used on icy roads, high abrasion resistance, and good flexing properties.

PELLETIZED NEWS

The rubber factory at the Vizara rubber estate near Nkata Bay, Nyasaland, will be modernized to boost output to 200 tons of rubber annually, including production of smoked sheet. At present only crepe rubber is produced.

THE KERALA GOVERNMENT will turn 10,000 acres of government forest land over to rubber cultivation during the current season, half to be planted by private cultivators and half by the government.

One method Malayan employers are adopting to encourage workers to greater effort is described in an official report. On a 2,000-acre rubber plantation in Pahang, employing 607 workers, records are kept of the production from trees in given tasks, from which the relative efficiency of the tapper responsible for the task is deduced. Basing on these data, the manager, making his daily rounds, paints dots of different colors on the trees. A white dot means the tapper is doing well—he gets an incentive allowance of 10% of his gross earnings; a green dot earns 6%; black—nothing; and red says that his performance is below par, and he will probably be fired or transferred to other work.

THAILAND'S total rubber exports for 1960 are put at 167,165 tons. The United States took 58,743 tons; Japan followed with 40,036 tons. Almost 20%, or 34,418 tons, went to Malaya. West Germany bought 13,922 tons; while Russia and Czechoslovakia together accounted for 11,182 tons.

American know-how for the production of polybutene will before long be made available to Japan Petrochemical Co., Furukawa Chemical Co., and Shin Nippon Chisso, in technical agreements, respectively, with Oronite, Standard Oil, and Cosden Petroleum Corp.

MITSUBISHI CHEMICAL CO., UBE KOSAN CO., JAPAN GAS CHEMICAL CO., and **TOYO HIGH PRESSURE CO., all intend to buy information on isoprene** from the National Petroleum Laboratory, of France, with the aim of eventually producing it on a commercial scale. The Japanese Government organization, MITI, will for the time being probably only approve the acquisition of the information, while keeping an eye on future trends in foreign countries before it will consider the question of approving actual production.

Under an agreement between Goodyear International Corp. and Dunlop Rubber Co. (Malaya), Ltd., a full range of Goodyear passenger and truck tires is to be made, under licence, in Dunlop's new factory being built at Petaling Jaya and will be distributed throughout Malaya.

COMMODITY TRADERS, LTD., an independent company of dealers will be operating in Singapore and Kuala Lumpur, starting July 1. Founders are two Malayan firms, Boustead & Co., Ltd., and Sandilands Buttery & Co., Ltd., and the American dealer, H. A. Astlett & Co., Inc., New York, N. Y., U.S.A. They will have equal interests in the new undertaking. The two Malayan companies, who are closing their rubber departments, have been dealing with H. A. Astlett; while their subsidiary, Boustead-Buttery Estates Agency, Ltd., acts as secretaries and agents for more than 40 rubber companies in Singapore and the Federation. Chairman of Commodity Traders is Leong Hoe Yeng; the directors are C. E. Gooderich, A. I. Charton, S. T. Koyle (Astlett), and D. A. Lewis.

(Continued on page 130)

First tire ever made in Iran gets an inspection from *(left to right)* His Excellency Khalil Taleghani, chairman of the board of B. F. Goodrich Iran S. A.; J. W. Keener, president of B. F. Goodrich Co.; His Imperial Majesty Mohamad Reza Shah Pahlavi, Shah of Iran; and O. E. Isenburg, managing director of Goodrich Iran. Production began last April at the B. F. Goodrich subsidiary's new tire plant which is situated near Teheran

Urethane Demand Expected to Reach 100-Million-Pound Figure by 1965

Synthetic Rubber

Demand for urethane elastomers, which reached two million pounds in 1959, and approximately six million pounds last year, should reach the 100-million-pound mark by 1965, if estimates of market observers are correct.

The figures break down this way: In the cable jacketing market, estimated to use more than 650 million pounds a year, perhaps 45 million pounds, the main market being reserved for plastics like poly(vinyl chloride), polyethylene, and polypropylene, which are cheap, except in applications where superior abrasion and solvent resistance of urethanes will make them vital.

In the mechanical goods market, perhaps 10 million pounds, in such applications as industrial wheels, seals, etc., where resistance to gasoline, solvents, and abrasion is important. This also would include gears, bushings, and gaskets, where there is competition with plastics as well as conventional rubbers.

Hose, tubing, and conveyor and drive belting, where abrasion and oil resistance and resistance to aging are vital, could run another sizable amount, perhaps five million pounds.

In still another category, heel lifts for women's shoes, and probably soles and heels for men's shoes as well, the ability of the urethanes to bear high loads, their abrasion resistance, and their good coefficient of friction when compounded for such use, give them an edge over conventional rubbers on the one hand, and such plastics as nylon on the other. The market is small at the moment, only a few million pounds, but could grow.

Still another field is elastic fibers, which now include Du Pont's Lycra and U. S. Rubber's Vicrene. Fibers are used in foundation garments, swimsuits, sock tops, and similar applications. Demand here is expected to reach 15 million pounds.

The total as broken down only reaches about 80 million pounds, but there are many other potential applications for urethanes which are hard to break down. For one thing, there are numbers of applications where they will replace metal and plastic parts, for reasons discussed in the special report on urethanes in this issue. For another, the product is so new that it may be used in applications now impossible with older materials.

A field where such companies as Du Pont are working hard is that of cast urethane tires. Cast urethane tires of several types have been produced, but practical development seems far off. One reason is urethane has a considerably greater heat buildup than conventional rubbers. Another is that it apparently does not have so great a coefficient of friction as other rubbers. A third is that its abrasion resistance, much better than that of natural rubber or SBR, drops rapidly with increasing heat. Still a fourth is the change in manufacturing procedures and junking of present equipment that would be necessary for producing a urethane tire. Still, modifications of the urethanes might open a tremendous market in this field.

One factor holding back demand for urethanes is the high price—ranging from $1.40 to $1.90 a pound, depending on type. However, in many applications its high abrasion resistance and resistance to oxidation, solvents, and oils mean a service life which can more than make up for higher initial price. Though it is too early to tell, it is probable that increased production will bring about lower prices. If the price could be brought down as low as 90¢, prospects for new markets would be greatly improved.

Consumption of new rubbers in the United States for April amounted to 115,660 long tons, contrasted with 120,916 long tons in March, according to the monthly report of The Rubber Manufacturers Association, Inc.

Consumption of all types of synthetic rubber during April totaled 82,655 long tons, against 86,008 long tons in March. Natural rubber consumption in April was 33,005 long tons, compared with 34,908 long tons in March.

Synthetic rubber accounted for 71.46% of total new rubber consumption, compared with 71.13% in March. The percentage for the first four months of the year was 71.14%, compared with 67.45% for the same period in 1960.

Consumption (in long tons) by type in April was: SBR, 68,005, against 71,110 in March; CR, 6,420, against 6,592 in March; IIR, 4,645, against 5,005; NBR, 2,460, against 2,559; stereo and other elastomers, 1,125, against 742.

Synthetic rubber production totaled 108,420 long tons in April, against 112,580 long tons in March; and exports were 22,965 long tons, against 27,693 long tons in March. Black masterbatch production was 3,301 long tons, against 1,935 in March; oil black masterbatch, 18,005 against 18,228; and oil masterbatch 2,082 against 1,188.

Latex

The drum latex market continued moderately busy during the May 16-June 15 period, with a sizable drop in production more than balanced by lower consumption. Very little latex now remains for shipment before August. The bulk latex market remained quiet, but steady.

Production of natural latex in Malaya for April was 6,327 tons, compared with 6,969 in March. For the first four months of the year, total production was 28,535 tons, contrasted with 39,833 tons in the same period last year.

United States consumption of natural latex in April was 3,285 tons, against 3,575 tons in March. For the first four months of the year, a total of 33,300 tons was consumed, compared with 39,167 tons during the like period in 1960.

Japanese consumption of natural latex is also reported down from last year, although figures are not available.

Stocks in the Federation of Malaya at the end of April were 5,298 tons, a reduction of 820 tons from the March figure.

Prices for ASTM centrifuged natural latex, in tank-car quantities f.o.b. tank car, were 35.07¢ per pound solids on June 15, against 37.17¢ per pound solids on May 15. Prices of synthetic

latices remained at 26 to 40.24¢ for SBR, 37 to 57¢ for CR, and 45 to 60¢ for NBR.

(All figures in long tons, dry weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Mar. . .	0	3,855	3,575	10,318
Apr. . .	0	*	3,413	9,404
SBR				
Mar. . .	8,500	——	6,866	9,254
Apr. . .	7,703	——	6,529	8,643
Neoprene				
Mar. . .	1,205	——	936	1,927
Apr. . .	1,167	——	864	2,058
Nitrile				
Mar. . .	763	——	904	2,124
Apr. . .	1,008	——	1,130	2,271

* Not available yet for period covered.

Natural Rubber

For the fifth time in the past six years, natural rubber growers will sell more rubber, in 1961, than they will produce. According to figures released by the management committee of the International Rubber Study Group, growers will produce 2,035,000 tons this year and sell 2,037,000 tons. The difference will be made up by sales from government stockpiles.

H. C. Bugbee, president of the Natural Rubber Bureau, noted that during the period of 1956 through early 1961, RSS #1 averaged 33.50¢ a pound, about 10¢ above the price of SBR.

Bugbee also declared that by 1963 the United States will produce some 225,000 tons of the so-called "synthetic natural" rubbers, polyisoprene and polybutadiene, with production of another 100,000 tons scheduled abroad. He said that polyisoprene and polybutadiene producers have indicated they can sell at 25¢ a pound.

"Natural producers could meet this price tomorrow and also sell profitably," he added.

Bugbee noted that "natural No. 1 RSS averaged 24¢ per pound for two years, 1953 and 1954. This was before the replanting program had really hit its stride. Given a few more years time in which to fully replant, and Malaya will be able to meet any synthetic price competition presently foreseeable."

An indication that business will be good for both natural and synthetic producers was given by A. J. Ashe, director of business research for The B. F. Goodrich Co., in a talk at the meeting of The Rubber Manufacturers Association, Inc., in Williamsburg, Va. Rubber consumption in this first quarter of 1962 will exceed this year's first quarter by 25%, he forecast. He said much of the increase will be accounted for by a boost in original-equipment tires, but with replacement tires and other rubber goods also showing growth.

Despite improved prospects for the future, natural rubber prices in both the futures and physical markets were off during the May 16-June 15 period. One major reason for the decline may be the persistent rumors that the United

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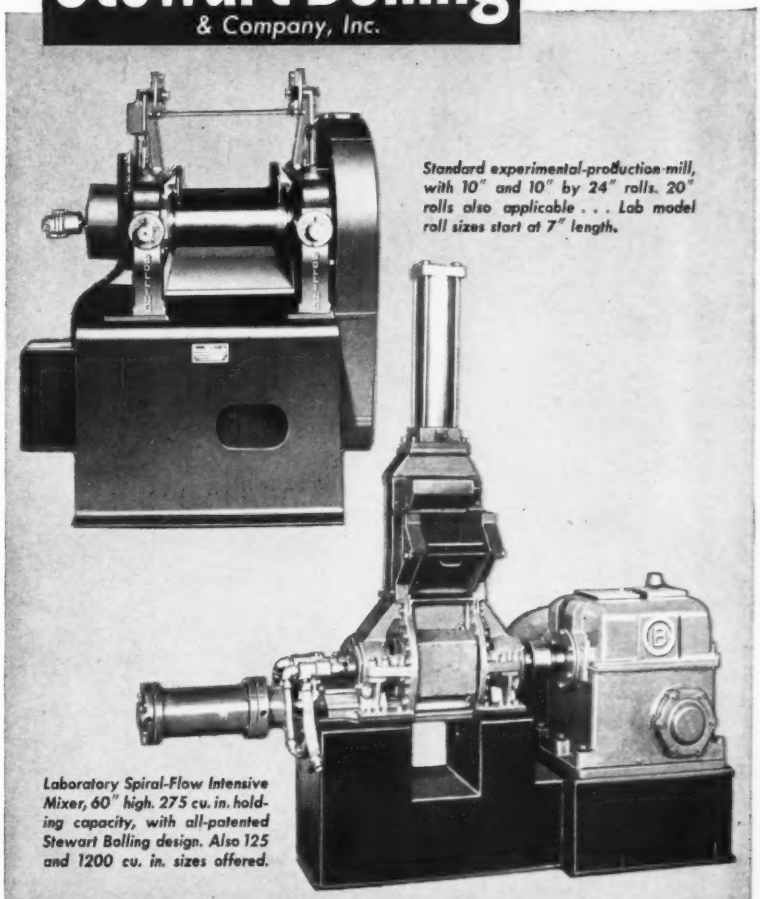

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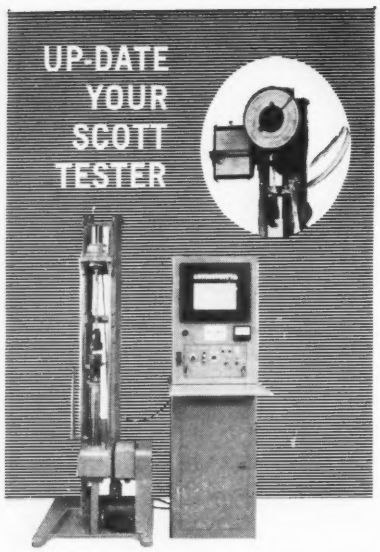

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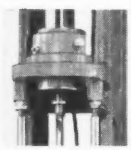

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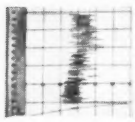

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SCOTT TESTERS

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market reviews

States Commodity Credit Corp. intends to revise its policy on selling stockpiled rubber from its present one of not selling below the market price of 30c for RSS #1. Some of the rumors predicted a cutoff price as low as 25¢. In spite of repeated denials by the CCC, the report definitely depressed prices.

May sales on the New York Commodity Exchange on the Rex Contract totaled 10,670 tons, against 10,400 tons for April; and Standard Contract sales, 700 tons, against 880 in April. Near rubber closed out the May 16-June 15 period at 29.75c, compared with 31.80¢ at the close of the previous period. There were 19 trading days in May and 21 in the May 16-June 15 period.

On the physical market the average price of RSS #1 for May was 32.03¢, compared with 31.27c for April, and 30.98¢ for the May 16-June 15 period, compared with 32.05¢ for the previous period. Average May sellers prices for other grades were RSS #3, 31.48¢; Amber Blankets, 27.12c; and Flat Bark, 21.91c.

REX CONTRACT

1961	May 19	May 26	June 2	June 9
May	31.75	——	——	——
July	31.85	30.95	29.90	30.40
Sept.	31.30	30.30	29.60	29.60
Nov.	31.10	30.15	29.40	29.50
1962				
Jan.	30.85	30.00	29.39	29.40

STANDARD CONTRACT

1961	May 19	May 26	June 2	June 9
May	31.75	——	——	——
July	31.75	30.95	29.80	30.25
Sept.	31.15	30.20	29.45	29.50
Nov.	30.95	30.00	29.40	29.40
1962				
Jan.	30.85	29.80	29.25	29.30
Mar.	30.85	29.75	29.20	29.25
May	30.80	29.75	29.20	29.25
July	——	29.75	29.20	29.25

NEW YORK OUTSIDE MARKET

	May 19	May 26	June 2	June 9
RSS #1	32.25	31.37	30.00	30.25
#2	32.00	31.13	29.75	30.00
#3	31.75	30.85	29.50	29.75
Pale Crepe				
#1 Thick	35.13	34.37	33.75	33.75
Thin	34.50	33.75	32.50	32.50
#3 Amber Blankets	27.37	27.00	26.00	26.25
Thin Brown Crepe	27.13	26.75	25.75	26.00
Standard Flat Bark	22.13	21.75	20.75	20.50

Reclaimed Rubber

There was a definite upswing in the reclaimed rubber market in the period between May 16 and June 15, and present indications point to continued improvement in business.

An eastern reclaiming company reported an increase in business, attributed to improved business for tires and automotive mechanical goods caused by the recent spurt in auto production. This upward trend will, however, probably not be pronounced until 1962 models go into production, the company predicted.

Another eastern reclaimer said that the period is expected to show the highest level of business for the year to date. Although vacation schedules will slow down demand, business is expected to resume in September at moderately high levels, this reclaimer reported.

A Midwest reclaimer also reported the period one of the best to date, with future prospects encouraging.

Production of reclaimed rubber in April was 21,350 tons, compared with 21,824 tons in March, according to the monthly report of The Rubber Manufacturers Association, Inc. Production in April of last year reached 26,209 tons. Consumption for April of this year was 20,730 tons, against 20,558 tons in March and 24,210 tons in April, 1960. A total of 1,100 tons of reclaim was exported in April, compared with 1,073 tons in March and 1,248 tons in April of last year.

For the first four months of the year production was 85,426 tons, consumption, 81,890 tons, and exports, 4,465 tons. During the same period last year production hit 108,716 tons, consumption, 103,319 tons, and exports, 5,154 tons.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.115
Third line	.1075
Inner tube, black	.17
Red	.22
Butyl	.16
Light carcass	.22
Mechanical, light-colored, medium gravity	.185
Black, medium gravity	.10

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims, in each general group separately featuring characteristic properties of quality, workability, and specific gravity, at special prices.

Tire Cord

World production of high-tenacity rayon tire yarn totaled 748 million pounds last year, contrasted with 439 million pounds in 1950, *Textile Organon* reported in its June issue. The figure compared with 746 million pounds for 1959.

For 1961, world capacity of rayon tire yarn is estimated at 868 million pounds, with a climb to 893 million pounds in 1962. Production hit a peak of 760 million pounds in 1955, but dropped off to 624 million pounds in 1958.

U. S. production figures hit a peak of 454 million pounds in 1954, or about two-thirds of the world total, from 308 million pounds in 1950. Last year they were down to 279 million pounds, compared with 332 million in 1959. Total capacity for '61 is 341 million pounds; so U. S. share of world

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Significant reductions in processing costs and simplified manufacturing techniques are now being achieved with the Polysar group of easy processing elastomers. This group includes general purpose, oil-resistant and self-reinforcing rubbers. They make possible high quality at low cost in an extremely wide range of moulded, extruded and new calendered products.

For complete information write to: Marketing Division, Polymer Corporation Limited, Sarnia, Canada.

Ask for Technical Reports
8-10B (Krylene 602); 9-3A (Krynac 803); 9-10A (Krynac 805); 9-9A (Polysar SS-260); 9-9B (Krynol 653); 11-1A (Krynol 654).

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POLYSAR KRYNAC 803 — **803** —medium oil resistance with a low Mooney viscosity contributes to easy processing during milling, calendering and extrusion for such products as oil seals and gaskets, gasoline and oil hose, moulded articles, belt covers.

POLYSAR KRYNAC 805 — **805** —recommended for applications requiring maximum oil resistance in easy processing compounds or in normal processing compounds where only low plasticizer loadings can be tolerated.

POLYSAR SS-260 — **SS-260** —exhibits a high degree of self reinforcement. Used in soling, household, sporting goods or other applications requiring optimum reinforcement, low gravity and ease of processing.

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Special Notice

The usual listing of classified rubber chemicals and compounding ingredients with prices which would normally be included in this issue of RUBBER WORLD does not appear this month. It became apparent that over the passing of time with additions being made, price changes being entered, and the lack of knowledge when materials became obsolete, the list had developed some inaccuracies, ambiguities, or other errors. Rather than attack the list piecemeal or use outdated information, it was felt that a complete revision was in order.

The listing will, therefore, reappear in the September issue of RUBBER WORLD as a brand new, up-to-date compilation of existing rubber materials with the latest prices.

Any supplier who has any reason to believe that his materials and prices are not now on file in our office please contact us as soon as possible so that our list will be of maximum use to our readers.

We hope that this omission this month will not too greatly inconvenience anyone, but we feel that the greater service of the revised listing justifies taking the time to be as accurate as possible and is more in keeping with RUBBER WORLD's policy of maximum service to the rubber industry. EDITOR.

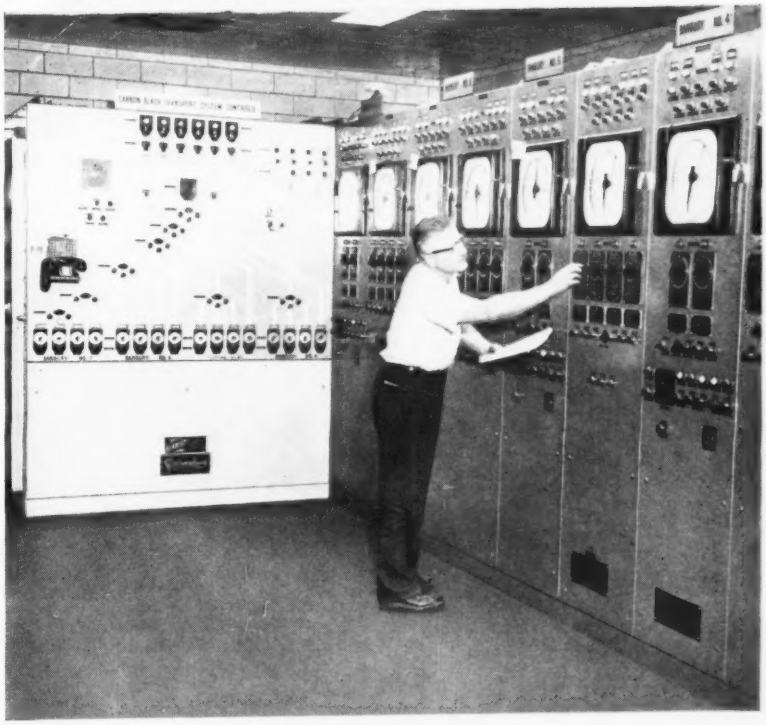
production is now only about 40%.

Behind the United States, the top producer of rayon tire yarn last year was the United Kingdom, with 78 million pounds. Second was West Germany, with 66 million pounds. Other large producers included: Japan, 59 million pounds; France, 44 million pounds; Netherlands, 38 million pounds; Italy, 33 million pounds; Brazil, 25 million pounds; Canada, 18 million pounds; Sweden, 12 million pounds; Czechoslovakia, 12 million pounds; Switzerland, 11 million pounds; Poland, 10 million pounds; Spain, 10 million pounds; and Mexico, 9 million pounds. Figures for the USSR, China, and Eastern Europe are not available, but the USSR is known to have a plant with 30 million pounds of rayon tire yarn capacity.

Packaged production of high-tenacity rayon yarn in the U. S. in May was 19 million pounds, compared with 18.8 million pounds in April, according to *Textile Organon*. Domestic shipments were 17.3 million pounds, against 15.2 million pounds in April; and total May shipments of 18.5 million pounds compared with 17.5 million pounds in

How The Goodyear Tire & Rubber Company gets

QUICK-CHANGE FORMULATION for Carbon Blacks and Oils



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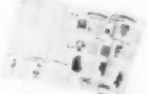

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market reviews

April. End-of-month stocks were 19.3 million pounds on May 31, compared with 18.8 million pounds on April 30.

RAYON PRICES

Tire Fabrics

1100/490/2	$0.69
1650/908/2	$0.58/.615

Tire Yarns

High-Tenacity	
1100/490	.51
1100/980	.51
1150/490, 980	.51
1230/490	.51
1650/980	.57
1875/980	.57
2200/980	.57
Super-High Tenacity	
1650/720	.57

NYLON PRICES

Tire Yarns

840/140	.92
1680/280	.92

Scrap Rubber

Activity in the scrap rubber market continued steady during the May 16-June 15 period, as consumption ran about even with last year's figures. Prices were up somewhat from the previous 30-day period, as mixed auto tubes rose from 4.50¢ per pound to 4.75¢, and black tubes rose from 5.75¢ to 6¢.

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$7.00/$11.00	$11.00
S.A.G. truck tires	nom.	nom.
Peeling, No. 1	nom.	nom.
2	nom.	nom.
3	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	4.75	4.75
Black	6.00	6.00
Red	nom.	nom.
Butyl	6.25	6.25

News from Abroad

(*Continued from page 123*)

Reports for 1960 by South African tire companies reveal a falling-off of business in the latter half of the year, involving the country as well as the rubber industry. Many factories worked below capacity last year. Dunlop (South Africa), Ltd., notes, and a considerable amount of foreign capital was withdrawn. This led to a tightening of import control which, in view of the lowered production, is in itself not considered harmful to the economy as a whole, but the tire industry is expected to feel the effects of lower levels of car assembly. Another source states that tires and tire materials have been put on the list of restricted imports.

The United States was Cambodia's best customer for rubber in 1960, taking 11,273 tons (including 2,686 tons of latex) out of a total of 34,499 tons (including 8,596 tons latex) exported in that year. France came next, with 5,521 tons, mostly latex; Russia bought 4,213 tons, none of its latex. Of Vietnam's total exports of 72,749 tons in 1960, 45,046 tons went to France.

PLANTA DE RECAUCHADO, Santiago, Dominican Republic, a tire-retreading firm, plans to install equipment to enable production of all the synthetic rubber the firm requires.

By late 1962 four Japanese concerns will be producing polypropylene under agreements with foreign concerns—three of them with Montecatini, and one with AviSun; and the importation of polypropylene will probably be stopped officially. There may be complications, however, since Montecatini is contesting the arrangement with AviSun, and Tokuyama Soda Co. is understood to be planning the manufacture of the material by its own process, patented in Japan. Several local spinning companies are showing considerable interest in this development, and at least two are said to be contemplating tie-ups with Tokuyama Soda—in the production of the plastics as well as of the fiber.

Polyurethane foam also is receiving much attention in Japan. Several groups are applying for permission to import the necessary know-how for its production, some in tie-ups with the German Bayer company, others with American Allied Chemical and Du Pont. Difficulties over patent rights, however, are delaying decisions in some cases. The lining of winter clothing is one of the uses planned for the foam.

THE GOODYEAR TIRE & RUBBER CO. (AUSTRALIA), LTD., last February celebrated the passing of a new milestone, the production of the 20,000,000th tire in Australia. A number of prominent personalities looked on as the New South Wales Minister for Labor and Industry, Hon. J. J. Maloney, helped the company's managing director, L. V. Winslow, remove the giant tractor tire from its mold.

The usual method of dealing with spontaneous combustion in coal mines is to cut off air supply and prevent noxious fumes from spreading, by erecting a barrier of sandbags, plugging crevices with sand or clay; or even —as a permanent measure—to build a brick wall. Neither method, however, provides the requisite, complete seal. After much experimentation, Dunlop has developed a polychloroprene latex sealant, which can be rapidly sprayed on to a barrier, effectively sealing an area of 80 square feet in about 10 minutes.

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Growth opportunity with a medium-size progressive eastern manufacturer of rubber belting and hose, who has an opening for an experienced, practical mechanical goods technical director. Strong in belting and mandrel-made hose, capable of developing new products completely from compounding and construction stages to factory processing and testing. Degree not mandatory. Submit detailed résumé to Mercer Rubber Company, 136 Mercer Street, Trenton 90, New Jersey.

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A good career opportunity to join the expanding technical department of a major supplier to the rubber industry.

The major function of this position will be to provide technical service to the rubber industry in domestic areas.

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Send resume in confidence to Box 2608

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Address: Box 2616 c/o Rubber World

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35-45 years old, personable. Heavy experience in compounding stereo specific polybutadiene for tires, etc., responsible position in technical service laboratory with some travel for customer contact. Address Box No. 2612, care of RUBBER WORLD.

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Standard hydraulic rubber molding presses, 36"x36" electrically heated platens, adaptable to either transfer or compression molding, and complete with temperature controls and cycle timers. Address Box No. 2611, care of RUBBER WORLD.

FOR SALE—LABORATORY MILLS—NEW AND USED. 6 x 12, 6 x 13, 6 x 16, 8 x 18. RUBBER AND PLASTICS MACHINERY OF NEW JERSEY, P. O. Box 1543, Trenton, New Jersey.

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FOR SALE: 1—6" x 16" THROPP 2-ROLL MILL, 2—24" x 24" Bolling hydraulic presses, 16" rams; 1—50-gallon jacketed Readco mixer, sigma blades; 1—10" x 20"—3-roll Farrel calender. CHEMICAL & PROCESS MACHINERY CORPORATION, 52 9th Street, Brooklyn 15, New York, HY 9-7200.

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FOR SALE: ROYLE—4½" RUBBER EXTRUDER STEAM OR OIL heated with 30-H.P. variable-speed drive—220/440 V, 3-phase. Excellent buy at $950.00. H & R Plastics Industries, Inc., Nazareth, Pa.

2200-TON BIRDSBORO HEAVY-DUTY RUBBER MAT PRESSES. Bed size 7' x 5'. Each press contains two 25" diameter rams. Complete with Intensifiers for 4000 psi. Farrel-Birmingham Roll Grinder. 36" x 240". 20-H.P. motor. Two 20" diameter grinding wheels with 7½-H.P. motor. Can be inspected under power. BELT PRESSES—1000-Ton Birmingham with sixteen 12"-dia. rams. 3 steam platens, 16' long x 46½". 15" stroke, 2 openings.—1500-Ton R. D. Wood, three 18"-dia. up-moving rams x 36" stroke. Bed size 50" x 240". National Erie 3½" Extruder, steamheated. 165-H.P. Vapor Clarkson Package Steam Boiler. 300 psi working pressure. Complete with all controls. EEmco 3-opening 24" x 30" Hydraulic Presses. 16"-dia. rams. Royle #2, 3¼" Rubber Extruder. Span Grinder, complete with 25-H.P. motor. Aetna 5' x 10' Steam Vulcanizer. With quick-opening-type door. Clean job. We carry a complete line of mixers, vulcanizers, calenders, churns, bale cutters, and other allied equipment for the rubber industry. WE WILL FINANCE. What do you need? What do you have for sale? JOHNSON MACHINERY COMPANY, 90 Elizabeth Avenue, Elizabeth, New Jersey. ELizabeth 5-2300. WE SPECIALIZE IN PLANT LIQUIDATIONS AND PURCHASES.

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WANTED: ROTARY KNIFE CHOPPER SUCH as Ball & Jewell, Cumberland, Foremost, or Abbe, with 40, 50 or 60 H.P. 220/440. Also Attrition Mill such as Susan or Foremost with 75 to 100 H.P. 220/440. Also other components to complete scrap rubber grinding system. To be used by manufacturer. State lowest cash price, condition, and descriptive specs and/or photos. Address Box No. 2610, care of RUBBER WORLD.

WANTED: USED 48″ to 60″ CAMERON Slitter. Must be in fairly new condition. Address Box No. 2615, care of RUBBER WORLD.

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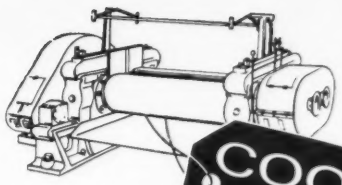

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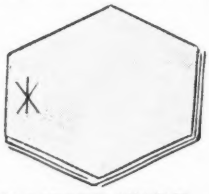

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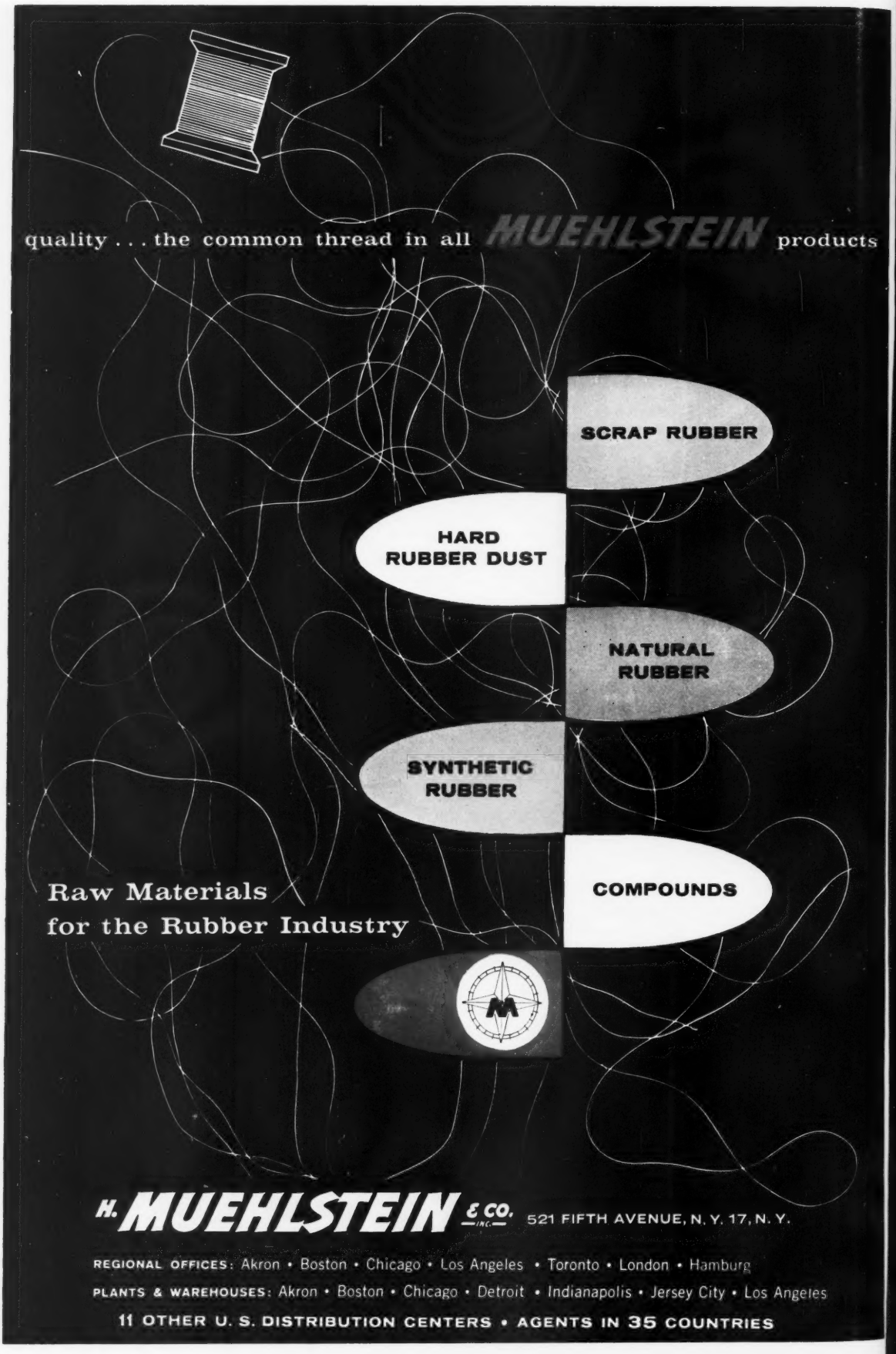
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